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SELECTION IN HEVEA.

To a considerable extent, the comparative permanence of the plants which are cultivated on estates in the tropics militates against their improvement. In the case of annual crops, the actual work of improvement is easier, because of the shorter time required to grow several generations, and the application of the results is facilitated by the fact that the grower can change his seed, and consequently the character of his produce, every year. On the other hand, once a tea or rubber estate has been planted and brought into bearing, the owner practically considers that part of the business has been completed for all time.

But if the replanting of an estate is not within the range of probability, there is nevertheless an opportunity of practising selection, in the case of Hevea, when opening up extensions which will no doubt be necessary from time to time ; and now that the rush of planting is over, this phase should receive the careful attention of rubber companies. If it does not, it will not be because the matter has not been brought to their notice, for the subject is one which is now being prominently brought forward by all the journals which are directly or indirectly interested in rubber.

A recent visitor to the Island has expressed his astonishment that, after our experience with Cinchona, nothing has been done in the way of seed selection in Hevea, and has reminded us that Java owes her pre-eminence in Cinchona to the selection of the highest yielding trees.

A beginning has already been made at Peradeniya, where two acres have been planted with seed from the old Henaratgoda tree which yielded 386 lb. of dry rubber in four and a half years. When these trees are old enough to tap, the yield of each will be carefully recorded, and any bad yielders removed. It must be borne in mind that in the present state of our knowledge, selection can only be based on yield. Ultimately it may be possible to correlate yield with some character of the tree, but that cannot be done at present.

It is urged that estates should set aside one or two acres which should be planted with seed from their best yielding trees. Other characteristics, such as freedom from burrs, might be taken into account when deciding between the best yielders. Subsequently, any of the progeny which proved below the standard should be cut out, so as to diminish as far as possible the risk of deterioration in the succeeding generation.

It does not necessarily follow that the descendants of good yielding trees will be good yielders. Under ordinary plantation conditions, the seed will most probably be the result of a cross, and hence the descendants may vary. The relative positions and times of flowering of the male and female flowers of Hevea brasiliensis do not exclude the possibility of self-fertilisation, but several observations point to the conclusion that cross-fertilisation is the rule. For instance, in both Perak and Ceylon, when Hevea flowered for the first time, only one tree flowered and no seed was produced, but in the following year, when two or more trees flowered, seed was obtained. Again, an isolated tree at Peradeniya which flowers abundantly every year has not borne any fruit during the years it has been under observation. Hence the necessity of testing all the trees grown from the selected seed.

It will be recognised by all who have any knowledge of plant breeding that the method outlined above is only an elementary one, and open to several objections. It is practicable but not the theoretically best. It will, however, serve admirably as a beginning and may well afford valuable data for more exact methods.

T. P

RUBBER.

BAD TAPPING.

The frontispiece of this number gives two illustrations of one of the many forms of bad tapping, namely, the gradual alteration of the slope of the cut as tapping proceeds. As will be evident from the facts that the trees were tapped with knife and pricker and that the tapping is in the wrong direction, these photographs were taken several years ago, but the same thing is not uncommon at the present day, and although it is generally recognised to be bad tapping, the full extent of the evil is not always realised.

Other things being equal, the quantity of rubber which it is possible to extract from a given area of bark depends to a great extent upon the number of times it is possible to tap it, i.e., on the number of cuts to the inch. Now, the number of cuts which can be made to the inch varies according to the angle of the cut, being greater with the "flatter" cut, i.e., when the angle made with the vertical channel is greater. In the present instance, this is true, whether the measurements are taken along the vertical channel, or perpendicular to the first cut. Therefore when the angle continually decreases, as it does in the cases illustrated, the number of cuts to the inch becomes fewer as tapping proceeds, and consequently the yield from the area tapped is less than it should be because of the fewer tappings possible.

The yield is further diminished by the failure to tap all the bark between the original cuts. To what degree this affects the yield it is not possible to estimate. No one doubts nowadays that latex is drawn to the tapping cut from some distance, and it is probable that this second effect is small in comparison with the first.

It will be noted that in one case, although a triangle of bark still remains untapped below the upper cut, the tapping cut has extended over the renewing bark of the second cut. In the other case, the untapped triangle has been "cleaned up" to make the bark level—a practice which has nothing to recommend it.

These photographs also illustrate another point on which some confusion exists. We talk of the number of cuts to the inch, in various numbers from eighteen to twenty-five according to the optimism of the individual, but there does not appear to be any general agreement as to the method of taking the measurements involved. Moreover, the distances measured are frequently too small—about an inch—so that a small error in measurement makes a large difference in the result, and the number taken as the number of tappings is sometimes the theoretical number of tappings possible (disregarding holidays etc.), instead of the actual number. It is notable that in tapping experiments, where the distance measured is a foot or more, and the number of tappings is known accurately, high numbers of cuts to the inch are not obtained.

But apart from that, the photographs show clearly that unless the tapping is absolutely parallel throughout, it is possible to describe the same tapping by widely different numbers of cuts to the inch. Thus in the second photograph, twelve inches of bark have been removed along the vertical channel, but only about six inches at the upper end of the cut (the direction of the cut has been rectified about two-thirds of the way down and a narrow triangle of untapped bark left). Supposing, therefore, the number of tappings was one hundred and twenty, measurements at the upper end of the cut would give twenty cuts to the inch, while measurements along the vertical channel would give only ten. If the tapping were described as twenty cuts to the inch with cuts one foot apart, one would deduce that after one hundred and twenty tappings half the original bark would be available, yet, as the photograph shows, no further tapping is possible. The example is, of course, an extreme one, but it serves to illustrate the point.

This brings us to the question, where is the distance to be measured in reckoning the number of cuts to the inch. The answer to that would appear to be quite clear, if an accurate standard is desired. The only distance which can be regarded as fixed is along the vertical channel. All other measurements, whether vertical or perpendicular to the cuts, depend on the accuracy of the tapping. The distance between the cuts is reckoned along the channel, and it does not appear logical to adopt another direction for other tapping measurements.

Measurements along the vertical channel give, for the same tapping, fewer cuts to the inch than measurements perpendicular to the cut. For example, with a tapping angle of 45°, twenty cuts to the inch measured perpendicular to the cut is fourteen measured along the vertical channel: with an angle of 60° to the vertical, the corresponding numbers are twenty and seventeen. The greater the angle made with the vertical the smaller the difference between the numbers obtained by the two methods of calculation.

T. P.

OPENING UP YOUNG RUBBER.

The following preliminary results of tapping experiments on young Hevea have been published by F. G. Spring in The Agricultural Bulletin of the Federated Malay States for April 1914.

The object of the experiments was to compare the Basal V system of tapping with that of the single quarter, half herring bone, and to find out the relative amounts of rubber obtained from a half herring bone, with different numbers of cuts.

The trees are planted $25 \times 12\frac{1}{2}$ feet. The number of trees in each plot is 100, and the average girth of the trees is practically the same. The trees had not been tapped prior to the beginning of this experiment. The half herring bones had one cut, two cuts eighteen inches apart, and three cuts eighteen inches apart, respectively. In all cases the lowest cut was 18 inches from the ground. The trees were tapped daily, 20 cuts to the inch.

The following table summarises the results for the first eleven months :—

Plot No.	1.	2.	3.	4.
Fraction of Circumference.	one quarter.	one quarter.	one quarter.	half.
Method.	half herring bone.	half herring bone.	half herring bone.	basal V
No. of cuts.	one	two	three	—
No. of trees.	100	100	100	100
Average girth.	22·6	21·7	21·3	22·3
Yield	152 lb.	220¾ lb.	180¼ lb.	304 lb.

The direction of the cut in the half herring bone is not stated.

MR. SPRING'S conclusions are as follows :—

Over the period of eleven months, reference to the tables will show that one cut (Single Quarter System) yields 152 lb. ½ oz. total rubber, two cuts 220 lb. 10½ oz. total rubber, three cuts 180 lb. 13½ oz. total rubber, while the Basal V yields 304 lb. 1 oz. total rubber. It should be remembered that in each plot tapping is conducted every day. Judging from the above figures it is fairly clear that it is not advisable, on young trees, to have more than two cuts on the Single Quarter System, and it is very doubtful if this number can be increased even on old rubber. On the supposition that old trees have a greater reserve and feeding capacity, it would be expected that they could carry a larger number of cuts, but it must be remembered that as the girth of the tree increases, the length of the cuts are correspondingly greater.

It is noticeable in this experiment that one cut, over a period of the first eleven months' tapping, yields approximately as much total rubber as three cuts. The Basal V far exceeds that of two cuts on the Single Quarter System, and this difference is likely to be maintained the second year with a similar V on the opposite side of the tree. During the 3rd and 4th year, in the case of the V, it will be necessary to resort to a top V, when there is a possibility of a reduction when compared with the same time of tapping on Single Quarters, but over the period of the four years it seems probable that the difference will be in favour of the V.

The writer favours the Basal V, if it is intended to continue on this system, in which case it might be preferable to place the V say 24 inches from the latex spout, and afterwards a similar V on the opposite side of the tree—this would allow of a shorter period for working on the top Vs.

Some planters have an objection to the V on account of its spoiling the shape of the tree in the course of a few years. This may be so, but personally I have never noted this peculiarity, and if, as they say, it should have a tendency to flatten out the tree, there is no objection to this as regards difficulties of tapping, the only objection would be if it reduced the yield. The writer's experience is that the V has given a gradual increase as tapping progressed and has shown no sign of a reduction.

[Experiments at Henaratgoda, daily tapping, show an enormous reduction, in the case of old trees, from top Vs following basal Vs.—ED.]

THE VALUATION OF RUBBER ESTATES.

Mr. F. C. Peck, the author of "Malayan Dollar Rubber Companies," and Director of the Mergui and other rubber estates, has just issued a book entitled "The Valuation of Rubber Estates," in which he sets out at length his methods and views on the subject. He disagrees with the "purchase of profits" system of valuation, as it takes no account of the increase or decrease in capital value of the estate during the period chosen, of the capital necessary to bring young rubber into bearing, and of the absence of any return during the period of development. His suggested methods, which appear to take into consideration all possible factors, are exhaustively discussed, and the book should prove highly instructive to valuers and investors. The views expressed on methods of planting and management, as affecting the value of an estate, are refreshingly modern. The chapters on the future price of rubber and the "natural price" of rubber will no doubt be studied with great interest.

SEED SELECTION ON OLD ESTATES.

Very few Hevea estates in the Middle East are now extending their planted acreage, the majority of owners being content to maintain their present fields in good order or to finish planting by taking in odd corners. The statistics for 1913 showed very few extensions, and those for the present year should show even less. But it is common knowledge that in the cultivation of even forest tree types certain areas may, in course of time, go out of cultivation, either from old age or numerous other causes. It is conceivable that Hevea trees, after they have been tapped ten, twenty, or even more years in succession, may be so damaged or have become so weak that the collection of rubber therefrom may cease to be profitable. Not that the trees might not yield any latex at all, but that better returns could possibly be obtained by planting up new clearings and starting on virgin trees. Furthermore, in areas liable to severe storms all the trees on a given acreage may, after successive tornadoes, be damaged beyond all hope of recovery. Hence arises the question of planting up very small acreages in successive years to make good for old non-paying areas.

SEED BEARERS ON ESTATES.

The seeds or plants for such purposes can, almost on every property, be obtained on the spot. Planters can now in most cases put down their nurseries from their own seed supplies. But herein lies a danger. It is the experience of most agriculturists that a "change of seed" usually results in a better crop. Hitherto most rubber planters have had to use, for their own clearings, seed supplies procured from notable estates, and there has not been any real opportunity for effecting seed selection in the proper sense. We make the suggestion that now is the time to lay out definite plans for selecting seed bearers for the small annual extensions which will be made in future years on estates having reserve forests at their command. There is no longer any necessity to "speed up" planting programmes, and there is plenty of scope in the selection of seeds for annual extensions of ten, twenty, thirty, or more acres.

SOURCES OF SEED SUPPLY.

There are now two sources of supply open to any up-to-date planter wishing to improve by seed selection the type of Hevea to be grown on any estate. The first is the older group of estates having seed bearers ten years and older ; the second is the oldest group of all, the parents of the million acres now planted, viz., those at the Botanic Departments in Ceylon, Malaya and Java. The supplies from the first-mentioned source will be as enormous as those of the latter will be limited, but even the latter will be sufficiently large to supply seed for a few thousand acres each year. We take the view that it is the first duty of an agricultural department to improve the stock of the country, and we know that every officer in every one of the departments referred to is in entire agreement with us on that point. Now seed selection to be of the greatest good involves something more than simply reserving the seeds from a number of old trees.

BOTANIC GARDENS AND SEED SELECTION.

It involves the selection of parent trees which conform to certain types, and seeing that pollination and fertilization between known parents occur. The progeny from an old or diseased tree could naturally not be as valuable as that from a perfect, good-yielding specimen. We are therefore led to conclude that seed selection, involving as it does careful control of all operations in connection with plant breeding, is a subject which should in the first case be handled by our botanic officers at Peradeniya, Singapore and Buitenzorg. There we have the oldest parent trees and men trained to carry out the necessary scientific work to ensure better results than could reasonably be expected from ordinary rubber estates.

We think, especially now that the demand for seed is declining, that there should be some form of agreement between the agricultural departments and the planters, whereby the former undertake to supply seeds from seed bearers in the botanic gardens, at a special price if necessary, to planters who wish to prepare for small annual reserve extensions. We can think of no better service to which the old carefully treated and well tended Hevea trees can be put. The result can only be determined as years go by, but there is every reason to hope that it would be satisfactory and lead to a permanent improvement in the type of Hevea under cultivation. Singapore and Ceylon could enter into an agreement to interchange supplies if change of country of origin was deemed advisable, each colony supplying planters with seeds according to terms of application.

The same procedure could be adopted between estates in different countries, but owned by the same Company.

SEED SELECTION ON ESTATES.

The selecting of seed parents on estates is a difficult but not impossible task. When lecturing to Ceylon planters many years ago (1905) certain suggestions were made which may perhaps be repeated with advantage. It was then stated that " seeds from trees which show irregularity in quality or quantity of latex should perhaps not be used for planting. It is difficult to give practical advice on the subject of selecting seed parents when all the trees are healthy and artificial pollination is not resorted to. Personally, I should select my seeds from the best developed trees on the estates—those who show the best growth of foliage and girth and a corresponding

lacticiferous system. It seems rather dangerous to select seeds from trees which, though showing good growth, have never been tapped; one may be selecting seeds from trees which, had they been tapped, would have given the minimum quantity of latex, or perhaps none at all. Provided the trees have not been roughly handled in tapping operations, there is no great mistake in selecting, as seed parents, those trees which are best developed and have given fair yields of rubber."

The problem of seed selection on Hevea estates is rendered more difficult by the fact that the latex vessels are not vital structures, and also by the arrangement of the sexes in the flowers. The above working plan, for use on estates, does not take these points into consideration, for the simplest reason that they do not, in the writer's opinion, fall within the province of the average manager on rubber estates.—INDIA RUBBER JOURNAL.

A NEW METHOD OF PREPARING SEED FOR MAILING.

Everybody conversant with the subject is well aware that the rapid loss of the viability of certain seeds of tropical fruits, such as the durian, the avocado, the mangosteen, marang, or the lanson, is due in a large measure to the invasion of fungi, and when these are excluded, provided that the seeds are otherwise properly packed in a medium of the right degree of moisture, there is really no sound reason why such seeds should not be successfully transported long distances, and retain their viability for a very considerable period.

MR. E. D. MERRILL, botanist of the Bureau of Science, who has recently returned from a journey to Java and Singapore, related to the writer that he saw in the Singapore botanical garden mangosteen plants grown from seed that were shipped from Singapore to New York, United States of America, and from thence returned to Singapore, after which they were planted and gave a germination of 50 per cent. These seeds were washed in a weak solution of carbolic acid and then packed in moist charcoal that had been disinfected with carbolic acid. Over three months elapsed between the time of the disinfection and packing of the seed and the planting.

The above experiment was carried out by MR. I. H. BURKHILL, director of the botanical garden in Singapore.—P. J. WESTER IN PHILIPPINE AGRICULTURAL REVIEW.

CACAO.

DISEASES AND PESTS OF CACAO IN SAMOA.

LIMUMEA OR BROWN ROOT DISEASE—HYMENOCHAETE NOXIA.

The mycelium of this fungus is present everywhere in virgin forest, and all forest trees are attacked with the exception of Palms, etc., irrespective of condition or of age, from the seedling to the forest giant. It grows on the roots, covering them with an encrusting layer, and, growing upwards even on to the stem of the tree, continues its development on the bark. The outermost edge of the fungus bears fruit bodies, and secretes a watery liquid through crater like openings. The fungus increases until the stem is ringed to a height often of 2 feet, so that the bark dries up and the tree dies. The process of exhaustion of the tree can take years or can be completed in a few days.

As measures of control, burning of diseased trees, and removal and burning of stumps are recommended.

Brown Root disease is not confined to cacao. It is found everywhere. The damage caused by it may be up to 1 per cent. in the first year, and at most 0·2 to 0·3 per cent. later, over the whole estate, per annum.

PINK DISEASE.

A fungus disease, also found in virgin forest and named "Pink disease" from its appearance, is caused by *Corticium Javanicum* Zimm.: in the young stage it forms white spots, but later develops into a uniform pink sheet. It also is not confined to cacao only. It attacks other trees much more, as, for example, Hevea. The fungus develops in the bark of medium-sized branches, without requiring any previous wound, and causes it to dry up and finally to die. In rare cases the tree heals up the diseased places in course of time.

Pink disease can be directly dangerous only on young trees up to 3 years old. On these it often advances so quickly, that the tree is killed in a short time. Excision and burning of diseased parts, and spraying, are recommended.

WITCHES' BROOM.

The once-feared witches' broom appears very rarely—less than 1 in 100,000 trees—on Samoan Cacao.

This phenomenon, which is known on forest trees in Europe, is an abnormal branch growth, and in the Kamerun Cacao, according to Faber, is caused by the fungus *Taphrina Bussei* v. Fab. What the cause is in Samoa has not yet been determined.

The only method of control is the vigorous pruning and burning of the malformed branches.

CACAO BEETLE—MONOHAMNUS RUSTICATOR F.

This name denotes the only stag beetle in Samoa as yet known as an enemy of cacao. In the Philippines there is a nearly related one, the flat-headed borer, whose larvæ however live in the wood of the cacao, in contradistinction to our beetle.

The female of the cacao beetle lays its eggs (apparently singly) in the bark of the cacao tree, preferably in the forks of the branches. The larva, which is at first whitish and later orange yellow, lives between the outer bark and the cambium, where it bores and forms a gallery covered by an outer layer of bark. These galleries often completely ring the tree, but it is not always fatal. Trees attacked are very seldom killed by the beetle, but serious injury is done by the entry of parasitic fungi through the damaged bark.

Control measures consist in killing the beetles, which are attracted by a light or may be found in houses during the day, and removal of larvæ from the tunnels and tarring of wounds. The pupæ can be killed by poking a strong wire into their chambers, or stopping up the entrance to the gallery. Spraying with Arsenic-copper-lime wash would perhaps prevent the laying of eggs on the tree.

LEAF BEETLE.

An introduced leaf beetle (*Adoretus vestitus* Bohem) attacks the leaves: it lives as a rule on Hibiscus and other ornamental and economic shrubs. Spraying with Arsenic-copper-lime wash should be carried out, when the beetle becomes too numerous.

TERMITES.

The termite *Calotermes* (*Neotermes*) *sarasini* Holmgr. is a serious pest of cacao in Samoa. On the other hand it does not attack Hevea. It penetrates into the tree below the collar and then works up into the stem, usually however only to the height of a foot or so. They have not yet been observed to attack sound cacao stems above ground, but a smaller termite appears in old stumps above ground in deep dried-up wounds in the wood of the tree. Some forest trees are especially attacked by termites, as *Rhus semarubaefolia* A. Gray and *Grewia Mallococcca*: these must be removed from wind belts and jungle on the edge of the estate.

SCALE INSECTS.

A white scale, *Dactylopius* (*Pseudoccus*) *citri* Risso appears frequently on cacao in Samoa, usually in the grooves of the fruit shell in whole colonies, and injures the cacao fruit by sucking.

It does not multiply quickly. Young twigs attacked should be removed and burnt: if too abundant on the fruit, spray with nicotine wash.

WOODY FRUITS.

On breaking open cacao fruits, some are found which cannot be emptied, the usually mucilaginous white flesh of the fruit having assumed a woody consistency. Often only a part has become woody, or the whole mucilaginous layer, the fruit shell and beans, have grown together. The woody places have occasionally a dark colouration, but usually are not to be distinguished from the surrounding tissue.

The cause of the phenomenon is still unknown, nor is it known whether it is infectious or whether it represents only abnormal growth. It is not very common, only about 0·1 per cent. of the fruits being affected. At the present time such fruits are burnt as a precautionary measure.

PREMATURE GERMINATION OF THE SEED.

Premature germination appears as abundantly as woody developments of the fruit, and is clearly a physiological phenomenon. Fruits not over-ripe and apparently quite sound, may exhibit this phenomenon. The fruit flesh has completely disappeared : it is replaced by buds and rootlets of the seeds, the cotyledons are already green and beginning to unfold. Such a fruit of course is worthless.

One can never quite decide from which tree these fruits came ; externally they seemed quite sound when gathered ; hence little can be done against it. If a tree occurs which frequently shows such abnormalities, one should avoid taking seed from it : it is not impossible that the abnormality is inherited. The best way is to cut out such trees.

LEAF SCORCH.

Cacao has strong brittle leaves, which look as though they could endure much knocking about. Yet in the young state, as in the case of many other tropical plants, they are very flaccid and hang down from the branches, even when they have grown to their full size. The delicate reddish young cacao leaves remain for some time tender and weak, and are consequently in a high degree susceptible to sun and wind. While strong winds blow off the leaves entirely, strong sunshine in conjunction with a dried atmosphere causes partial death, which as a rule proceeds from the tip of the leaf.

RATS.

Ripe cacao fruits are eaten in this country by rats. The rats eat holes in the fruits to get at the beans, from which they gnaw off the mucilaginous coat. One finds the beans lying uninjured under the trees.

The poisoning of rats is very uncertain and may do much damage in other directions. Bacteria have been tried without success. The only way to keep down the rats is to maintain many wild cats or a pack of dogs on the estate. In the course of time wood and undergrowth disappear from the plantation, and, at harvest, with its consequent disturbance, the rats tend to disappear, till scarcely one gnawed fruit is to be found. It is further suggested that no papaws should be left amongst cacao to provide food for rats.

FLYING FOXES.

Quite recently flying foxes (*Pteropus* sp.) have caused damage to cacao plantations. One frequently sees nowadays ripe fruits eaten by flying foxes. As opposed to rats, which eat a hole generally in the upper third of the fruit, and pick out the beans from the opened shell, flying foxes begin at the apex : they hang on the branch next the fruit so that their mouth reaches the apex, and they often eat away more than half. They feed only on the fruit sap, which they squeeze out from the parts bitten off ; thus they chew up the mouthful thoroughly, and they attack both the fruit shell and the beans. The remainder after chewing is rejected, and consequently one recognises the offender by this, since with rats, as above mentioned, the undamaged beans are found under the tree.

Control measures suggested are, knocking them down on clear nights, and possibly infecting them with a typhus bacillus.—Der Tropenpflanzer.

CLAYING CACAO BEANS.

In claying cacao as described in the Tea and Coffee Trade Journal, the fermented unwashed beans after being partially dried are heaped up and worked with powdered red clay till it adheres to the mucilaginous matter of the beans, which are afterwards spread out to dry. It is usual to again heap them up, sprinkle with water and work them with the feet till the beans get a polish, after which they are subjected to a final drying.

The alleged object of claying is to render the beans impervious to moisture, to prevent decay, and to preserve the aroma of the kernel: but, it might also be added, to preserve, if not to increase the weight, and impart the typical chocolate colour.

The Trinidad Board of Agriculture is making an effort to check claying which has of late years been abused, and has warned all concerned that excessive claying if persisted in will be brought to the notice of Government with a view to making it a punishable offence.

There is at present little difference in price between poor cacao that has been clayed and good beans; and it is therefore in the interests of cacao planters, particularly in Ceylon where cacao is not subjected to claying, that some check should be placed on the practice.

C. D.

PRUNING CACAO.

There is much diversity of opinion with regard to correct pruning; which branches to remove, which to leave is a problem that still remains unsolved; most planters agree that trimming of some sort is necessary, some believe that the tree must be given a good shape and proper balance. This is sound enough reasoning, but there is an essential point that has not been cleared up, namely: What is the correct shape? Should a tree be too heavy on one side, we reason in a sound manner, that that side should be lightened to give the tree a proper balance, but with regard to shape the planter often errs in shaping the tree irrespective of conditions, in consequence too much healthy bearing wood is removed. Any branch is capable of producing fruit: and the little whips and small branches protect the tree in several ways, chiefly by giving to the plant a larger area of foliage, which means that greater manufacture of plant food takes place.

Leaves are absolutely necessary to the health of the tree, for a plant is largely dependent on food made through the activity of the leaves. Separation of carbon from carbonic acid gas of the air is effected in the green cells of the leaf. During daylight the carbonic acid gas is decomposed, carbon retained and oxygen set free. Respiration also takes place through the leaves—they are, so to speak, the lungs of the tree.

Without a sufficient leaf area there is the possibility that an adequate supply of plant food may not be available to meet the requirements of the crop and that many of the young pods will accordingly die. Excessive pruning also causes a drain on the food supply owing to the cambial activity which ensues after cutting.

I mention these points not because I think a cacao tree should not be touched at all—on the contrary; I believe that proper, light pruning, and at the proper time is necessary—but that more thought and study may be given to this important work.—D. C. Plummer in Trinidad and Tobago Bulletin No. 79.

RICE.

THE FORM OF NITROGEN FOR RICE.

One of the most generally accepted teachings in all agricultural literature, based, however, mainly upon experiments with dry-land crops, is that of the high availability of nitrates, it being considered that of all the forms of nitrogen nitrate is the most readily taken up from the soil and used as food by plants. As a result of the prevalence of this view nitrates have been used for rice in America, and indeed sodium nitrate still is recommended at the present time for this crop by some authorities.

It has been known in oriental countries for some time, however, that nitrate is not the most profitable form of nitrogen to apply to rice. Nagaoka, in Japan, demonstrated in 1905 the superiority of ammonium sulphate in a series of pot experiments. He found that while the effects produced by nitrates were variable and discordant the yields were greatly increased in every instance by the use of ammonium sulphate. As a result of his experiments Nagaoka concluded that the value of ammonium sulphate and nitrates stand in the ratio of 100 to 40.

In 1907 Daikuhara and Imaseki also found ammonium sulphate to be much more effective for wet-land rice than either sodium nitrate alone or a combination of the two forms. The value of nitrate was also found to be considerably less when applied in conjunction with organic manures. Likewise it has been shown in several of the Provinces of India that other forms are superior to nitrates. Coleman and Ramachandra Rao, for example, pointed out that organic fertilizers produced a marked stimulation of the growth of rice in Mysore, while nitre had but little effect. In 1911 the writer published the results of experiments conducted at the Hawaii station which showed the great superiority of ammonium sulphate over different nitrates.

Notwithstanding these facts some American writers continue to recommend sodium nitrate for rice and to discuss rice soils from the same standpoint as dry lands.

It is not necessary to go into a theoretical discussion of this question at this time further than to state that abundant experimental evidence has already been brought forth in various parts of the world to prove that nitrate is not the only form of nitrogen available to plants. Results obtained at the Hawaii station show that nitrate can hardly be considered to be the principal source of combined nitrogen for many plants when grown in the state of nature. It is known that nitrates are ill suited to assimilation by rice.

From the yields of experiments it is apparent that nitrate of soda produced only slight increases either when applied before transplanting or at intervals during the growth of the crop. Ammonium sulphate, on the other hand, brought about notable increases in every instance, the larger harvests having been obtained from the single application before planting. Repeated

applications were made for the purpose of guarding against the loss of nitrate through leaching, but this appeared to have no advantage over the single application.

From pot experiments, where drainage was entirely prevented, the great superiority of ammonium nitrogen over nitrate was again demonstrated. In a series of pot experiments with the use of sterile quartz sand, it was found that where nitrate was the only form of combined nitrogen present rice made very poor growth, whereas ammonium forms seemed to be well suited to its needs. The net result of all these experiments forces the conclusion that nitrate is not a suitable form of nitrogen for rice, but that ammonium compounds are well adapted to its needs.

In the rice-producing countries of the Orient organic manures are the chief source of nitrogen applied to rice soils. It has long been the custom of the Chinese and Japanese to grow some legume between crops for the purpose of enriching the soil. Sometimes the legume is grown on one field, cut, and then distributed over others, so as to gain the benefit of green manuring with as little interruption in the growing of rice as possible. In addition, all sorts of organic nitrogenous substances are freely applied. In Hawaii, on the other hand, almost no rotation is practised.

From a single experiment conducted by the agronomist of this station, however, it was found that by ploughing under a few months' growth of alfalfa just previous to the planting of rice the yield was 50 per cent. greater than has ever been obtained on this soil by the application of any commercial fertilizer. In this experiment the alfalfa was grown on one plat, but was cut and applied to another, so that the effects may be attributed to the organic manure directly rather than to a combination of aeration and other effects, the soil being prepared and submerged very soon after making the application. Moreover, the application of different organic nitrogenous fertilizers at various times has always resulted in substantial increases in the yield of rice on this soil. In a series of pot experiments, for example, soy-bean cake was compared with ammonium sulphate. In this experiment nitrogen from each of the two sources was applied at the rate of 70 pounds per acre. The yields obtained were as follows:—

AMMONIUM SULPHATE VERSUS SOY-BEAN CAKE AS FERTILIZERS FOR RICE.

Treatment of plat.	Straw.	Paddy.	Total.
	Grams.	Grams.	Grams.
Ammonium sulphate ...	215	138	353
Soy-bean cake ...	167	122	289
Check	80	61	141

From the above data it will be seen that soy-bean cake brought about an increase of 100 per cent. in the yield, but was considerably inferior in this respect to ammonium sulphate. The reasons for the superiority of ammonium sulphate over organic forms of nitrogen are discussed in greater detail later. In this connection it is of interest to point out that the plant absorbs the principal part of its nitrogen during the early period of its growth; readily available nitrogen therefore is needed when the rice is young, and since the production of available nitrogen from organic forms requires considerable time the application should be made some time in advance of planting, a precaution that was not taken in the above experiments. Through a period of years, however, the total effects would probably become more nearly equal.

AMMONIFICATION AND NITRIFICATION IN RICE SOILS.

The analysis of a number of rice soils, taken from the field when wet and analyzed immediately, has shown that rice soils contain considerable quantities of ammonia, varying from a few parts up to as much as 50 or 60 parts per million. On the other hand, in the submerged condition nitrate is rarely found in more than mere traces, frequently being entirely absent.

Since good effects are known to follow the use of organic manures, and, furthermore, that ammoniacal nitrogen is especially effective with rice, it becomes a matter of interest to ascertain whether or not ammonia is formed in rice soils at rates sufficient to supply the needs of rice.

Accordingly a series of ammonification experiments were carried out with dried blood as the source of nitrogen, using varying amounts of water applied up to and beyond the saturation point.

It was found that ammonification proceeded at a slow rate only, if at all, until a certain moisture content was reached (about 10 per cent. in the case of soil 292, and 15 per cent. with that of 461), above which vigorous ammonification took place, which steadily increased up to an approximate two-thirds saturation, then decreased as complete saturation was approached. There was, however, active ammonification in the completely saturated soils. This seems to prove that ammonia is formed in submerged soils and that organic nitrogenous fertilizers will give rise to nitrogen available to rice under conditions that prevail in rice cultures.

As is well known, the formation of ammonia results from the activity of a wide range of soil organisms, bacteria and fungi, some of which are aerobic and some anaerobic. While the above data show that ammonification is more active with moisture supplies below the saturation point, being greatest at approximately two-thirds saturation, nevertheless, the fact that ammonification can take place in saturated soils is of very great importance in the growth of rice. It makes possible the production of available nitrogen in rice soils without the necessity of employing cultural methods that are primarily designed to bring about aerated conditions.

Free oxygen being essential to nitrification, it seems justifiable to conclude that nitrification does not take place to any considerable extent in a submerged soil. In order to throw positive light on the question, however, search was made for nitrates in various submerged soils about Honolulu, but in no instance was more than a few parts per million found.

In some laboratory experiments it was further found that practically no nitrification took place in submerged soils.

The process of denitrification, however, is of considerable importance in this connection. As is well known, free nitrogen gas may be one of the products of the decay of organic manures. Likewise, it is also known that certain denitrifying bacteria break down nitrates into nitrites, ammonia, and finally into free nitrogen gas. The conditions under which the denitrifying bacteria function are extremely varied, but the two conditions most favourable for their activity are a source of food supply and a lack of free oxygen. In the rice soils of Hawaii these conditions are abundantly met ; the high content of organic matter guarantees a source of food, while supersaturation excludes the air.

As indicated above, the denitrification processes may be conveniently divided into two classes, (1) those causing a liberation of nitrogen from organic materials, and (2) those bringing about a reduction in the nitrates present. The latter of these has been the subject of considerable study at the Hawaii station.

In the pot experiments conducted some time ago for the purpose of studying the nutritive value of different forms of nitrogen it was found that in every instance the addition of nitrate to submerged soil resulted in the formation of comparatively large amounts of nitrite within a few days after the time of application. In sand cultures similar effects were observed except where complete sterilization was effected. Furthermore, wherever any considerable amount of nitrite was formed, more than 5 to 6 parts per million, toxic effects were produced, while still greater amounts caused the rice to turn yellow and later to die.

Nitrite, however, was not produced to any considerable extent when organic ammoniacal nitrogen was the only form of combined nitrogen present. A further objection to the use of nitrates as fertilizer for rice is found in the fact, therefore, that nitrates become reduced to nitrites, which are extremely poisonous to rice. Nitrate, then, is unsuited to the nutrition of rice, and in turn may give rise to a substance that is distinctly poisonous.

THE MANAGEMENT OF RICE SOILS.

During the past few years an increasing amount of study has been given to the question of soil management ; and cultural methods, the rotation of crops, and various methods of soil treatment are coming to be viewed in their relation to this general question. Investigations on special phases of this subject have thrown new light on the important question of soil fertility in general and on that of submerged soils in particular.

In an investigation on the solubility of the island soils some data of interest in this connection were recently obtained. Likewise Coleman and Ramachandra Rao studied the effects on the yield of rice of aerating the soil.

The solubility of substances in submerged soils has been found to be abnormally high, the amounts of the several mineral constituents going into solution in water having been found to be considerably greater than were obtained from any of the dry-land soils of the islands. After the wet soil was allowed to thoroughly dry out, however, the solubility in water was found to be greatly decreased, falling to about the same degree as that of dry lands.

Similar data have also been obtained by Coleman and Ramachandra Rao, in Mysore. This seems referable in the main to soil colloids and the formation of soil films in the air-dried state. The overcoming of film pressure and diffusion of dissolved materials upon resubmergence require considerable time, so that the amount of soluble plant food coming into contact with the absorbing root surfaces of rice would be considerably less when planted in a soil that had been thoroughly dried out. Later the mineral constituents would, of course, regain their former state of solubility, but just how much time would be required for the re-establishment of a permanent concentration cannot be definitely stated. It seems certain, however, that a lowering of the availability of the mineral constituents would temporarily result from a thorough drying out of the soil.

It is now the practice of the growers, both on the mainland and in Hawaii, to plough their rice lands some weeks before the flooding time, in the latter case immediately following each harvest, so as to permit as much aeration of the soil as possible. As would be expected the aeration promotes nitrification, so that by the time a new crop is planted nitrate has accumulated to a considerable extent. Upon submergence the nitrate thus formed becomes partially leached out of the soil and in part converted into poisonous nitrites. The nitrification therefore leads to a direct loss of nitrogen on the one hand and to the formation of a substance toxic to rice on the other. If, however, Hawaiian rice soils are not ploughed or cultivated after the water is turned off and the previous crop harvested little or no nitrification sets in. The puddled state of the soil and its compacted condition effectively exclude air. It is only after cultivation and consequent aeration that active nitrification sets in.

Unfortunately no experiments showing the practical effects on the growth of rice as produced by aeration against nonaeration have been conducted at this station. Such experiments, however, have been made in Mysore, the results of which are in complete harmony with the inferences drawn from the nitrogen transformations above referred to. As a result of experiments carried on through two years, Coleman and Ramachandra Rao found that a considerable gain in the yield of rice was obtained by leaving the land in the unploughed condition during the time between crops, the ploughing for the new crop being deferred until just before the new crop was planted. By growing a legume between rice crops all needed aeration can be brought about; while the nitrates formed during this period would be absorbed to a large extent by the legume, and in addition free nitrogen from the air would be added to the soil through the growth of the legume. Upon ploughing under the legume, ammonification will set in, thus furnishing available nitrogen for the next rice crop. The nitrogen requirements of the rice would therefore be met, and other beneficial effects that are believed to result from the rotation of crops would be secured. There is little ground to doubt that better conditions would thus be established and greater profits obtained.

SUMMARY.

(1) From fertilizer experiments carried on through seven crops it was found that the application of 150 pounds per acre of ammonium sulphate produced notable increases in the yield, but 300 pounds per acre proved the more profitable. Potash and phosphoric acid were without effect. The

application of ammonium sulphate to both the spring and autumn crops yielded considerably more profit than when made to the spring crop only. The residual effects on the autumn crop from the spring application are small. The immediate effects obtained from making the application to the autumn crop were about the same as those obtained with the spring crop.

(2) A complete fertilizer proved no more effective than ammonium sulphate alone, whereas the application of both ammonium sulphate and potassium sulphate caused a decrease as compared with that obtained from ammonium sulphate alone.

(3) Nitrogenous fertilizers only are recommended for Hawaiian rice soils, and for immediate effects a given amount of nitrogen in the form of ammonium sulphate will produce greater returns than from organic sources. Under no circumstances should nitrates be used as fertilizer for rice.

(4) With nitrate as the only source of combined nitrogen for rice poor growth results. In addition nitrates in submerged soils become reduced to nitrites, which are poisonous to rice. Ammoniacal nitrogen, on the other hand, is well suited to the needs of rice.

(5) Very little nitrification takes place in submerged soil ; ammonification however, goes on, not so vigorously as in aerated soils, but sufficiently to supply the nitrogen needs of rice, provided sufficient organic matter is present in the soil.

(6) A rotation of crops, including the ploughing under of a legume, is recommended. It is believed a system can be worked out whereby a legume can be grown between crops and then ploughed under, thus gaining the benefits of the rotation and at the same time permitting the growing of two crops of rice annually.

(7) Rice soils should not be ploughed and then allowed to lie fallow between crops. Nitrification sets in immediately after aerated conditions are produced and the nitrate thus formed become converted into poisonous nitrites upon submergence, or are lost through leaching. When no rotation is practised it is better to leave the land unploughed until just before planting the next crop.—HAWAII AGRIC. EXPT. STA. BULL. NO. 31.

ERADICATING WATER WEEDS FROM IRRIGATING DITCHES.

Disking canals while the water is running is reported as a successful means of eliminating growths of water weeds in the Bear River and Cache valley projects in California. An ordinary disc harrow is stripped of its seat and double trees and the tongue is cut 4 ft. in length. To this are hitched two ropes, leading to teams, one on each bank ; by adjusting the length of these ropes the harrow can be run on either slope or on the bottom. This digs up the roots and the plants float down and are removed. The above canals were very foul three years ago when MR. WHELAN, the manager, introduced this system ; now very few weeds are left. It is cheaper than mowing and it does not interrupt the flow of water —MONTHLY BULLETIN.

TOBACCO.

BRIEF NOTES ON THE TOBACCO INDUSTRY.

B. SCHERFFIUS.

Tobacco, like the potato, has made the conquest of the world. It is used by every race and is grown in practically every agricultural country. The annual production is now $2\frac{1}{2}$ billions pounds weight.

It has assisted in the development of new lands and aided in the maintenance of old ones, produced wealth for its cultivators and increased the revenue of nations.

The development of the industry has been the work of four centuries, during which time many facts have been ascertained by experience, some learned by accident and others by careful scientific investigation. One of the most important truths established by the application of science to tobacco cultivation is the annihilation of the old idea that this crop exhausts the soil to an extraordinary degree.

The tobacco plant readily adapts itself to a great variety of soils. It can be produced on any soil where other agricultural crops will thrive ; and yet there is no other plant so easily affected by the chemical and mechanical conditions of the soil. Each distinct type requires a particular soil and climatic conditions, as well as certain definite methods of curing and fermenting to give to it those qualities of colour, texture, flavour and aroma for which it is prized.

The colour of a soil is in some measure indicative of its character and possibilities. Light coloured soils generally produce bright coloured tobaccos, and dark soils dark coloured tobaccos. Soils containing a large percentage of clay and hence having a high water-holding capacity tend to produce a thick heavy leaf that cures to a dark colour, while soils consisting largely of sand produce tobaccos thin in texture that cures to a bright colour.

As is well known, tobacco is manufactured into various forms for consumption. The general classes might first be distinguished, i.e. (1) cigar tobacco, (2) manufacturing tobaccos which include all types not used for cigars. Each of these two classes may be subdivided into other types, depending on their special uses, methods of growing and curing and on the variety of seed used. In the case of cigar tobaccos there are three general types, corresponding to the three parts of the cigar-wrapper leaf, binder leaf and filler leaf.

In the manufacturing tobaccos are such types as yellow tobacco, perique, white burley, Turkish cigarette, dark export, etc. Although the finished leaf of these various general types is quite different in characteristic, a large number of the varieties are interchangeable, e.g., "Yellow Pryor," grown on suitable clay loam, in certain climates, and cured by the open fire method produces an excellent dark export tobacco, having a large thick elastic leaf, of a deep brown or red colour, and containing a high per cent. of nicotines and gummy matter. Seed of the same variety, when grown upon a typical yellow tobacco soil containing a large per cent. of sand and a small amount of clay, produces, when cured in the same manner, a leaf with much less body, less nicotine and gummy matter, more mild in flavour, of finer texture, and of a pale red or piebald colour. But if the latter be cured by the flue process, the result will be a leaf of a bright lemon yellow, with a slightly greenish tint, having a sweeter flavour. This example will serve to illustrate the powerful influence exerted by soil, the climate and methods of curing.

CHARACTERISTICS OF A GOOD TOBACCO.

At one time any tobacco that would burn was considered fit for consumption, but along with the improvement and development of the plant, man's taste has been educated to the point of demanding certain essential characteristics in the tobacco intended for his use. There are many shades and variations of these characteristics depending on the trade catered to, because in their estimate of tobacco, as well as of wine, the best judges do not agree. However, certain points of excellence are always demanded.

(1) If a tobacco is intended for cigar wrapper, the leaf must have style and be elastic, thin in texture, finely grained, light and uniform in colour, and the stem and veins be small and of the same colour as the leaf. The leaf should be as free from flavour as possible, it being the portion that comes in contact with the mouth. The standard of excellence for wrappers is the Sumatra leaf.

(2) The binder for cigars should possess qualities similar to those of the wrapper leaf, except that it should be thicker to give it greater strength, and it should have good aroma, the standard being the said leaf types.

(3) If intended for cigar filler it must have good burning qualities, producing a white solid ash which does not flake off, and fall on the clothing. It should also be highly fermented, and possess a fine flavour and aroma, and have good body. The standard for this type is the Veulta Abajo leaf.

(4) If intended for plug wrapper, it must have style, elasticity, toughness, body, and be of good flavour, the highest standard being the yellow flue cured type.

(5) Plug filler, intended for chewing, must have a certain toughness, so that it will hold together while being masticated, and not break up into small particles in the mouth. It must also be rich in flavour, and have a high absorptive capacity, for the reason that large quantities of flavouring liquids and sauces are added. It is this ability to retain large quantities of flavouring sauce, that gives White Burley its popularity.

(6) Tobacco intended for pipe smoking and for cigarettes must be free from the gumminess so desirable in chewing tobacco, which would interfere with the cutting or granulation of the leaf by machinery. The bright tobaccos are at present the fashion for cigarettes, and are growing more and more popular for pipe smoking. The most desirable types are bright Turkish, light burley grades, and the light grades of yellow flue cured.

Often the desired standard of flavour is not found in any one tobacco, and it becomes necessary to blend different grades. This blending is sometimes done from the standpoint of economy, when a certain proportion of a perfect flavoured but high-priced leaf is used to give quality and character to a cheaper tobacco, which has all the requirements except flavour. Perique is the notable tobacco for blending purposes, having the strongest aroma of any tobacco on the market.

TOBACCO CALLED FOR BY EUROPEAN MARKETS.

Great Britain furnishes one of the best markets for tobacco. The United Kingdom imports more than one hundred millions of pounds annually, consisting of the following types :—

(1) Bird's-Eye cutter, which is a very bright, smooth, thin and clean leaf with as little gum as possible. The colour of both the upper and under sides of the leaf must be of uniform and similar shades of bright colour, and the stem must be of a light brown colour on the outside, and white on the inside. Each section into which the stem is cut presents, on the cut surface, the appearance of a bird's eye and hence its name. It is used for pipe smoking.

(2) Spinning leaf which is a type having good length, smoothness, strong and elastic texture, rich and oily, and is usually of a brown colour, but brighter shades are growing in popularity. It is used for making spun roll or strand.

(3) Shag is a coarsely cut, manufactured product much used in England. It has a brown colour, considerable body and but little gum. It is used for pipe smoking.

(4) Yellow, or flue-cured tobacco, has a bright lemon colour and mild flavour. The leaf used for this type comes from the clean sound lug grade of the yellow tobacco, and is finely shredded for cigarette smoking, and finely cut for blending with pipe tobacco

(5) White Burley type need not be of any uniform size, and is selected principally from the reddest grades of burley. It has a mild flavour and a great power of absorption. It is used as filler for navy plug.

(6) Plug wrappers are rich brown leaves, smooth in structure, medium in size and strong and elastic in texture. These are not much in demand, because the consumption of plug tobacco is quite limited. Some of the fancy plug fillers have the same general characteristics, only they are the short and more imperfect leaves.

Germany.—(1) "German Saucer" is a sweet, fair bodied leaf of fine fibre and stem, gummy, without fatness and either of a clear cherry red colour or mottled with yellow, technically called piebald. The surface is

gummy, the leaf of good length, with considerable weight of body. It is prepared for consumption by treating with sauces of a peculiar flavour and character. The fibres must be yellow after treatment, and the leaf black.

(2) German Spinner is a very heavy bodied leaf from twenty-four to twenty-six inches long, full in width, of fine stem and fibres, very oily in fat, so that it will come out of the process of fermentation supple and strong, tough and elastic in texture and of a very deep dark brown colour. This is used for spinning into roll or strand for chewing.

Germany takes a variety of grades for consumption or distribution, mostly dark tobaccos.

France.—The French grades may usually be reduced to two distinct lines of classification as heavy and light, with considerable irregularity as to grade, and deficiency as to the distinctiveness in type. It is said that France puts up the best smoking tobacco in Europe, and the product is made uniform by the proper mixing of tobaccos in large bins, containing thirty to forty hogsheads each.

Spain.—This country takes common and medium lugs and low leaf of all types, which are classified as A's, B's and C's. Most of it is used for smoking, the better grade for cigar binders and fillers, and the low grades are granulated and used for pipe smoking and making cigarettes.

Italy.—Italian tobacco is also classified as A's, B's and C's. Type A is a large showy and silky leaf, twenty-five to twenty-six inches long, of delicate fibre and texture, and of a solid deep brown colour. Only moderate body is required, and just enough oil-fat to make it elastic and strong. It is used for wrapping cigars. Type B varies between heavy and light tobacco ; when the heavy is required, the type consists of leaf of good body, dark brown colour and more general richness than type A, and it must be from twenty-two to twenty-five inches long. Type C is short common leaf, eighteen to twenty inches in length, moderate weight of body, and is used as filler and binder in the manufacture of cigars.

Austria.—Consumes principally one type, a wrapper leaf very smooth and fine in fibre, of very solid, firm and glossy texture, above medium heavy body, but not the heaviest and most fleshy types, and of a perfectly uniform brown and piebald colour. A very essential quality is toughness and strength of the leaf.

Russia.—Russia buys light low grades, consisting of a good size leaf, mild in flavour, and with little body and gumminess. A large bulk of Russian tobacco is prepared in Germany.

Switzerland.—One of the popular types in this country is known as Swiss wrapper. It is a broad leaf twenty-six to thirty inches in length, silky, of fine fibre and stems, and of a dark brown or chestnut colour. The spaces between the lateral fibre should be wide and a combination of thin web and fine fibre is desired. It is used for wrapping cigars.

The Netherlands.—This country takes one distinct type as Dutch Saucer, similar in all respects to German Saucer except that it is thinner and more silky in texture,

Belgium.—This country likewise buys one special type, known as Belgian cutter, which is a short leaf, of a mottled or piebald colour, and of fine body without fat or oil ; very similar to Dutch Saucer except that the grade is lower. It is used for cutting purposes in the manufacture of pipe tobacco.

Denmark, Norway and Sweden.—The tobacco consumed in these countries, is for the most part grown in the United States, but rehandled and prepared for their markets mainly in Bremen. The leaf is sweet, fleshy and of a bright mottled or red colour.

It would appear that dark tobaccos are more in demand than the bright leaf, but this is undoubtedly due to the fact that the cultivation of bright tobacco is at present confined to small areas, hence the supply is much more limited than that of the dark types. Wherever bright tobacco markets have been developed, the popularity of the coloured grades has been pronounced.

Those who take up the cultivation of tobacco for the first time need not go through every step in order to buy for himself the experience that other countries have acquired, for he has at his command the accumulated knowledge of the rest of the world. At the same time he cannot start right away in establishing an industry, for there are local climatic and soil influences to be considered as well as markets to be found.

The first step is the experimental stage, and before starting this work the experimenter should be thoroughly informed as to the nature of the tobacco plant and its requirements ; if not, the reason of good or bad results obtained will not be understood and the conclusions drawn will be faulty and of little value.

JAFFNA EXPERIMENTS.

Work to be undertaken at Jaffna (1) variety tests ; to include choice selections from all standard types, making an effort to grow, harvest, and cure each, under its most favourable conditions.

(2) A series of fertilizer experiments to more accurately determine the soil requirements.

(3) Curing experiments involving the most widely practiced methods such as air, open fire and flue-curing.

(4) Experiments in fermentation of the cigar types, and of ageing the varieties grown for cigarette, pipe and chewing purposes.

After satisfactory results have been obtained will come the time of commercial expansion. In submitting samples to the markets only properly cured tobacco and the best grades of the types should be sent.

If Ceylon proves to possess a climate and soil in certain sections favourable to the production of high-grade tobacco, settlers in these localities are to be congratulated, for the production of high-grade tobacco ensures prosperity. However, nothing can be fully determined without experiment, which, properly conducted, will give us the answer we want and point the way to commercial development.

B. SCHERFFIUS.

FRUIT.

ORIGIN AND VARIETIES OF THE BANANA.

Mr. Paul Popenoe, Editor of the Journal of Heredity, deals with the origin of the Banana in the last issue of that Journal. He is of opinion that we must seek for the origin of the fruit in the Indo-Malaya region, but believes that the wild bananas of the present day do not represent the ancestral type and are merely escapes from cultivation.

In view of the fact that the wild fruit is so full of seed, the banana was probably at first grown as a root crop and the tender heart also used as food; while under cultivation it developed edible fruit.

Beccari's idea is that all the bananas of to-day are the result of hybridization of original forms now disappeared, and that subsequently the propagation of choice varieties must have been carried on by means of off-shoots.

In respect of antiquity Beccari suggests that it was first cultivated in the Pliocene epoch, assuming that it was in that age that man appeared as a distinct species.

The generic term Musa is derived from the old names Mose, Mauz, Maz, which are traceable to the Sanscrit Moca.

Banana is the vernacular name in the African Kongo, while Plantain comes from the Spanish "plantana" and Latin *plantanus* indicating some confusion with the plane tree.

The genus Musa comprises 32 or more species and at least 100 sub-species, many no doubt confused. The Philippines and the Indian Archipelago are richest in forms, followed by Ceylon.

The genus is divided into two broad sections: Eumusa with edible fruits and Physocaulis with inedible fruits. The first is commercially divisible into bananas and plantains, the latter being larger and coarser and generally eaten after cooking.

The cultivated varieties are innumerable, said to be due partly to their great variability and tendency to bud variation.

In Ceylon where the term plantain is applied to all forms of the fruit, we may classify as follows (1) Curry plantains and (2) Table plantains. To the first class belong the varieties which do not mature properly and are therefore used in the green state for cooking into curries. The chief of these is the "ash-plantain" which is of a grey colour and angular in shape. There are also cylindrical green varieties which are used in the same way. To the second class belong a number of types (1) "Kolikuttu," the table plantain par excellence. It is variable in size but the shape is cylindrical, the peel of medium thickness and the edible part mealy and free from acidity. Though most highly esteemed locally it is not much appreciated by Europeans owing to the absence of fruit acid. To this class also belongs the Suwandal common in the Kandy District, and also the huge Jaffna plantain (2) "Puwalu"

or sugar plantain, the fruit of which is inclined to be somewhat angular, has a thick peel and a subacid flavour. The puwalu is the best of a type which is not reckoned as particularly good, the others (e.g. Anamalu) being rank in flavour and better suited for stewing or for making puddings. (3) "Honarawala." This is the type to which the sour plantain (embul-honarawala) belongs. The latter is the most common market variety and is largely supplied to shipping. The size is variable but the fruit is generally small, thin-skinned and acid in flavour. The best of the honarawala type is the "rata-honorawala" which has a delicate fruity flavour and a very thin skin. It is best eaten very ripe. (4.) "Rat-kehel" or red plantain. This is a fat rank-flavoured mucilaginous variety only suitable for stewing and for puddings though in the North it is eaten raw. A yellow-skinned variety of this is also found.

There is no doubt, however, that natural hybridisation is producing new forms with different flavours, and one often meets with specimens possessing the combined qualities of two varieties, and this makes it difficult to identify them as belonging to any one of the types specified above.

C. D.

CULTURAL DIRECTIONS FOR THE PAPAYA.

P. J. WESTER.

The papaya is one of the commonest fruits in the Philippines, ranking next to the banana with respect to wide distribution, largely because of its rapidity of growth and early fruiting habit as compared with other fruits.

The papaya is a large succulent herb, of exceedingly rapid growth, and when well cared for produces ripe fruit within twelve months from the planting of the seed. It is very impatient of water standing around the roots and succeeds on well-drained land, sandy or loamy soils being most suitable; as it is easily injured by strong winds the papaya should be planted in well-sheltered situations.

From the grower's point of view there are three kinds of papayas: The hermaphrodite papaya, the flowers of which are perfect; the pistillate, or, as it is commonly called, the female papaya; and the staminate, or male, papaya. Of the two fruiting kinds, the hermaphrodite is preferable to the female since it is usually sweeter and better flavoured; a very great point in its favour is the fact that it is more apt to reproduce itself true to seed than the female.

The hermaphrodite papaya is distinguished by its more or less oblong or pear shaped form, sometimes, in its best types, approaching the shape of a cucumber. The female papaya is recognized by its more roundish shape, prominent "nose," and a large seed cavity that frequently is filled with seed.

PROPAGATION.

The seed bed should be prepared by thoroughly pulverizing the soil by spading or hoeing the ground well and clearing away all weeds and trash. The seed should be sowed thinly, about 1 to 2 centimeters apart, and

covered not more than 1 centimeter deep with soil, and the bed then watered thoroughly. In the dry season it is well to make the seed bed where it is shaded from the hot midday rays of the sun, for example, under a tree; or, it may be shaded by the erection of a small bamboo frame covered with grass or palm leaves. If the seed is sown during the rainy season a shed should always be put up over the seed bed to protect the seed from being washed away and the plants from being beaten down by the rains.

Transplanting the seedlings in the seed bed, setting them about 7 to 10 centimeters apart, when two or three true leaves have appeared, will very materially aid in the successful transfer of the seedlings to the field.

TRANSPLANTING TO THE FIELD.

When the plants have attained a height of about 7 to 10 centimeters, they are ready for transplanting to their permanent place in the garden or the orchard.

Unless the transplanting has been preceded by a good rain, the plants should be thoroughly watered before they are removed from the seed bed. In order to reduce the evaporation of water from the plants until they are well established in their new quarters, about three-fourths of the leaf blades should be trimmed off.

In transplanting, take up the plants with a large ball of earth so that as few roots as possible are cut or disturbed. Do not set the young plant deeper in the new place than it grew in the nursery; firm the soil well around the roots, making a slight depression around the plant to hold water, and then give it a liberal watering.

In order to protect the tender plant from the sun until it is established, it is well to place around it a few leafy twigs at the time of planting. Unless the seed is of an unusually good strain it is also a good plan to set out two or three plants to each "hill." This gives the grower a better opportunity to discard male and undesirable female plants without destroying the "stand," than if only one plant is set out in each place.

If the plants can not be set out in the field at the time indicated, transplant them from the seed bed to the nursery, setting the plants 30 to 40 centimeters apart in rows 1·2 meters apart, or more, to suit the convenience of the planter. While the best plan is to set out the plants in the field before they are more than 30 centimeters tall, the plants may be transplanted from the nursery to the field with safety even after having attained a height of 2 meters, *provided that all except the young and tender leaf blades are removed, leaving the entire petiole or leafstalk attached to the plant*, and provided that, in those regions where the rains are excessive during the wet season, the work is performed during the dry season. If the entire leafstalk is left on the plant it withers and drops and a good leaf scar has formed before the fungi have had time to work their way from the leafstalks into the stem of the plant. As the tissue of the papaya plant is exceptionally favourable for the rapid development and spread of fungi, if the leafstalk is cut off *close to the stem*, the fungi invade the stem from the remaining short petioles and the plant dies.

Papayas should be planted 4 meters apart each way on land of average fertility; on very rich land it may be desirable to set out the plants 4·5 meters apart.

CULTURE.

While the plants are small the intervening space may be planted with some upright-growing cover crop, such as mongos or cowpeas, but when the papayas come into fruiting the best plan is to keep the land clean cultivated during the dry season. For the best success it is essential that the plants are irrigated whenever the leaves show signs of wilting, and being of exceedingly rapid growth the papaya requires more water than most plants. In order to reduce evaporation and irrigation expense, the land should be cultivated as soon as it is in condition for cultivation after the flooding. The harrowing may be repeated once or twice before the field is again irrigated.

During the rainy season special attention should be given to see that there is no stagnant water in any part of the papaya plantation, and that all surface water drains off rapidly.

REJUVENATION OF OLD PLANTS.

When a plant has grown so tall that it is difficult to gather the fruit, which also at this stage grows small, cut off the trunk about 0·75 to 1 meter above the ground. A number of buds will then sprout from the stump, and in a surprisingly short time the old stump will have been transformed into a papaya plant in full bearing. These sprouts, except two or three, should be cut off, for if all are permitted to grow the fruit produced will be undersized.

SEED SELECTION.

Seed should be saved from the best fruits only. By this is meant not so much a large fruit as one that is *sweet and well flavoured*, with a small seed cavity and few seeds. Oblong should be preferred to round fruits in saving seed, since they grow on plants having both stamens and pistils in the same flower, and these being very largely self-pollinated, the seeds produced from such flowers are more likely to reproduce their kind than the seed from round or melon-shaped fruits, which grow mostly on female plants.

All male plants should be promptly destroyed wherever they appear, as not only are they unproductive, but by their pollen being carried to others which are fruiting they tend to produce degenerate plants when these are grown from the seed obtained from plants growing in the vicinity of the male plants. There is no need to fear that the others will not fruit if the male plants are destroyed, for the reason that there are always plants near by having *perfect* flowers which provide sufficient pollen for the pollination of the females.—Philippine Agricultural Review.

GIRDLING FRUIT TREES.

The June issue of the Queensland Agricultural Journal has further reference to this subject.

Poenicke sums up the advantages thus :—"The fruit-girdle represents an extremely simple and perfectly reliable expedient, based upon the most recent scientific investigations. It simplifies the cultural methods in the orchard exceedingly, while it increases the yield and makes it far less dependent upon special knowledge and accidents. At a trifling cost, the fruit-girdle allows of a remarkable saving in current expenses."

Girdling is a means of constricting the stem or branch without running the risk of wounding it, in trees which have reached the fruit-bearing stage. In vigorous trees there is surplusage of wood-growth that has to be removed by much labour at pruning time. If the fruit-girdle can be used to lessen this surplusage, without unduly impairing the vigour of the tree, and at the same time to promote fruitfulness, it is a valuable device.

The girdle consists of a zinc band fastened tightly round the trunk of the tree, or, in strong-growing trees, around the principal branches. It is notched along its upper and lower margins, and the corresponding tooth-like projections gradually bend outwards in a sloping direction as the stem or branches increase in diameter. In this way the swellings of the cortex are allowed to expand without enveloping the fruit-girdle by its exuberant growth.

The girdle can be removed when necessary, but it was found that it could be left on for two or three years without injury.

The Queensland Journal considers girdling a simple means by which the products of assimilation are accumulated and stored up in the formative sap and the composition of the sap so regulated as to enable the formation of wood and fruit to proceed in their proper proportions. It is claimed that not only is the yield and quality of the fruit improved but early maturity is also secured,

An important matter in fruit cultivation which is little understood locally is to regulate the relation between wood growth and fruit production. If there is good uniform growth without the formation of too much wood, conditions are favourable for the production of good fruit, but if the tree is making too much wood and not allowing sufficient nourishment for fruit, the physiological balance is disturbed. This latter condition must therefore be remedied by the art of the horticulturist.

C. D.

OLIVE CULTIVATION IN GERMAN EAST AFRICA.

For some years, experiments in the cultivation of olives have been carried on by settlers in Leganga, German East Africa. Plants have been imported from Palestine and have been established in the Kilimanjaro and Meruberge districts, and very favourable results have been obtained. As the forests of those regions contain wild olive trees, improvement of the latter will be attempted.—Der Tropenpflanzer.

THE MANURING OF BANANAS.

According to the Queensland Agricultural Journal the fertilizer recommended by Brunnich for Bananas on good soil consists of 3 cwt. sulphate of potash, 2½ cwt. dried blood or nitrate of lime, and 4 cwt. superphosphate per acre, to be applied twice a year. The fertiliser cost £12 10*s.* annually, the cost per stool working out at 10*d.*, with this manure the average yield was 345 bunches (3,035 doz. bananas) valued at 3*d.* per dozen or £38 per acre.

Poor soils with double the amount of fertiliser gave 457 bunches (4,330 doz. bananas) valued at £54 per acre.

The quantity of fertilizer per stool would be about 3½ lb. at each manuring.

C. D.

SOILS AND MANURES.

SOIL DENUDATION BY RAINFALL AND DRAINAGE AND CONSERVATION OF SOIL MOISTURE.

The following paper was written by A. Howard, Esq., Imperial Economic Botanist and distributed to the members of the meeting of the 8th Board of Agriculture held at Coimbatore in December last.

The whole of the cultivation area of India affected by the monsoon is subject to the loss of fine soil by rain wash. These losses are accentuated by the uneven distribution of the rainfall and by the occurrence of heavy falls which often exceed six inches in a single day. The amount of this annual loss varies according to local conditions and is by no means restricted to those areas where the slope of a land is considerable. Even in tracts of the Gangetic plain like North Bihar, where the difference of level between the high and the low lands is only a few feet, the damage done by wash is enormous and the amount is hardly realised. One of the results of this wash in Bihar has been to remove the fine soil-particles from the higher lands and to deposit them in the rice areas. In consequence, the fertility and water-holding capacity of the high lands can only be kept up by the application of organic manures, while the thickness of the stratum of soil suitable for rice in the rice areas is much greater than is necessary for this crop. The extra soil washed down into the rice areas can be regarded as so much unproductive and lost capital.

At Pusa, some attention has been paid to this subject during the last eight years and methods have been devised to check the loss of fine soil by rain which used to take place every monsoon. The large fields have been divided into smaller areas so as to break up the run off into units and so dissipate its destructive energy. Each small field is surrounded by trenches and narrow grass borders, which serve both to conduct away the run-off and also to hold up the fine soil. A process of natural terracing goes on, the fields level themselves, and the loss of soil is largely prevented. Each field deals with its own rainfall only.

The prevention of soil denudation by rain wash in India seems to be a matter well worth the attention of the Agricultural Department. I am aware that work is already in progress on this subject in some localities, but there can be no question that it is not receiving that attention the subject deserves. Much is being done to find the cheapest manures for crops, but less attention is being paid to the loss of fine soil which, if prevented, would render manure not so necessary in the future.

It is in the planting areas of the East, however, that the best examples of soil denudation are to be seen. In the hill tracts in the centre of Ceylon, an area which is now covered with the gardens, the original forest canopy was removed to make room for coffee which later gave place to tea. Little or no provision was made at the time to retain *in situ* the fine soil of the

original forest, and in consequence the loss of soil has been enormous, and is still going on. The water retaining power and fertility of the tea soils of the hill regions of Ceylon have fallen off on account of the loss of fine particles, and large sums are spent annually in adding green and other manures to the land. The agricultural capital of the Island has been allowed to run to waste, and can never be replaced by any system of manuring. This shortsightedness is remarkable considering the local examples of terracing for rice on the sides of the valleys where the preservation of the soil has been carried to a fine art. There is no doubt that the best way in which the planting industry could have been assisted would have been by the enforcement of a regulation to immediately terrace all lands from which the forest canopy had been removed. I have heard that such a regulation is in force in Java. I am not familiar with the local conditions of the planting industries in the Federated Malay States, in Assam, and in Southern India, but I understand that in several of these tracts, such as the Malay States, Southern India, and the Darjeeling tea tract, this question of rain wash is one of the greatest importance. It is difficult of course to remedy the mistakes of the past by the measures open to Government, but it seems to be a matter for consideration whether something cannot be done in the future in India, where forest land is sold for planting purposes. The difficulty will be to frame rules with regard to terracing which, while allowing of the development of the country, will, nevertheless, check the destruction of the natural agricultural capital,– namely, the fine soil, rich in organic matter, made by the forest. The aim should be to allow the development of the country to go on, but to prevent the dissipation of its natural resources. The example of Ceylon is sufficient to indicate the damage which results in these matters from the absence of a strong guiding hand.

DRAINAGE.

In a country like India, where most of the rainfall is frequently compressed into a period of about four months, the subject of drainage is apt to be disregarded. Where so much is heard about irrigation it is difficult to realise that some tracts of the country, Bihar, for example, suffer from too much rain, and are in need, not of elaborate systems for the distribution of canal water, but rather of some provision for getting rid of the excess precipitation. Drainage is also of importance in canal-irrigated tracts, not only in North-West India, but also in such river deltas as the Godavery, where weirs have been built across the rivers so as to convert an ancient system of inundation into one of the perennial irrigation.

In Bihar, drainage and soil denudation are intimately connected. The high lands are impoverished by wash, and the fields below are water-logged by the extra water which drains over them from above. The system adopted at Pusa of making each field deal with its own rainfall not only checks the loss of fine soil, but also serves as an efficient method of drainage. The run-off is collected from the field trenches into large channels, which lead to the low lying rice fields where such water is frequently welcome. If the year is one of flood, the extra water brought by these trenches makes no appreciable difference, as in any case the crops on the flooded areas will be lost. Further, it appears that under this system of drainage the total run-off is less than if there were no drains. By splitting up the rainfall, more of it seems to be absorbed by the upper lands than when the run-off is unchecked.

A similar system of drainage to that devised at Pusa can be seen applied on a large scale in Italy, particularly in Lombardy. Great care is taken, in Italy, to keep the system of surface drains in order and also to cut off from low-lying areas the run-off from higher lands which otherwise would convert these low areas into swampy ground.

The advantages of a drainage system in the alluvium are very great. More water is absorbed by the soil, wash is largely checked, and the lower fields increase in fertility to a remarkable extent. If the low-lying areas in North Bihar, which now only grow poor crops of rice, could be drained they would be among the finest wheat lands in the world. Not only are the lower fields rendered more fertile by drainage, but their cultivation can be carried out at a less cost and much more rapidly than before. The continuous wheat plot at Pusa furnishes a good example of the benefits which arise from drainage. Previously this field was often water-logged, and only gave good crops in years of poor rainfall. After being drained the yield increased, and after five crops of wheat without manure there is no sign of any soil exhaustion. The only soil exhaustion I have experienced in Bihar is that due to the loss of available nitrogen by water logging, which has been shown to produce in a single wheat crop a loss of 16 bushels to the acre.

The indigo estates in Bihar are now paying considerable attention to drainage, and already the beneficial results obtained have exceeded expectation. On one estate near Pusa, for example, a beginning was only made during the present year, when an area of about 25 acres was divided up into four fields which were also protected from the surface wash of higher land. The results were at once apparent, and the owner is convinced that a proper system of drainage is the first condition in any scheme of land improvement in Bihar. If the present rate of progress is maintained, the indigo estates will soon furnish examples of the benefits of drainage in Tirhoot, and it may then become a matter for consideration whether or not the improvement of the Division should not be taken in hand by Government, and proper studies made of the rivers and other drainage lines. This has been done in Italy with marked success, not only from the point of view of crop production, but also from that of the prevention of malaria.

CONSERVATION OF MOISTURE.

Experience at Pusa and at Quetta confirms the enormous importance of a proper system of conservation of soil moisture. Similar results have also been obtained in the *barani* tracts of the Punjab and elsewhere. In the alluvium the greatest source of loss of soil moisture while the land is under a rabi crop is undoubtedly the hard surface crust which forms after the application of irrigation water. A dry surface is a necessity if the maximum crop is to be produced under *barani* conditions. Applying one irrigation to the wheat crop at Pusa does more harm than good if the surface skin, formed by the water, is not broken up thoroughly afterwards.

The most efficient instrument so far found for breaking up surface crusts in the alluvium, and in producing a fine dry mulch for a rabi crop is the lever harrow. This implement is an ordinary harrow, provided with a lever by which the slope of the tines can be altered at will. By sloping the tines backwards the harrow passes over a young wheat crop without injury and at the same time breaks up any surface crusts leaving a fine dry mulch behind. It has also proved of great use in the cultivation of Java indigo in Bihar during the hot season. At Quetta its use has increased the yield of dry crop wheat from five to nineteen maunds to the acre. In Bihar these harrows have been taken up by the wheat growers and, on estates where they are in use, are regarded as indispensable.—The Indian Tea Association Scientific Department Quarterly Journal.

THIRD REPORT ON THE PARTIAL STERILISATION OF SOILS FOR GLASS-HOUSE WORK.

E. J. RUSSELL, D.Sc.

(*Continued from p. 44*)

RESULTS OBTAINED IN THE NURSERIES.

As a general rule germination is retarded on freshly steamed soils, and the young plants show marked retardation in comparison with others grown on untreated soil. The effect is less visible on soils that have been exposed after heating and is also less on light than on heavy soils or those rich in organic matter. It is probably due to some of the decomposition products formed by the action of the heat on the soil organic matter, but it depends so much on the plant, the season, the management, and the conditions generally, that it is very difficult to investigate satisfactorily: indeed, it is not invariably produced, and sometimes an increased rate of germination and seedling growth is obtained almost from the outset. This happened at Rothamsted during the past season, and a still further acceleration was produced by mixing well rotted dung with the soil.

The retardation is a source of some anxiety when it appears, but it soon passes away, and is, in any case, more than counter-balanced by the fact that the seedlings are invariably freer from disease than those raised on contaminated untreated soil, such as often has to be used in the nursery.

Heated soil behaves rather differently from unheated soil on watering, and therefore care is needed until the men get used to the new conditions.

Flowering and Early Fruiting.—The results obtained with tomatoes in pots were entirely similar to those described in earlier reports and need not be discussed again. The steamed soil not only gave larger crops but earlier crops, and there was no disease brought in by the soil. Very satisfactory results were obtained by steaming old cucumber soil in winter and putting it straight into pots for the growth of early tomatoes.

The fear was entertained last year that tomato plants grown in steamed borders might develop too vigorous a habit of growth to "set" their fruit well. It was true that the "setting" was always good in the Rothamsted experiments, but there the plants were grown in pots where the root system was necessarily restricted. The conditions of a border, on the other hand, allow of much more extended root development, and of a greater tendency to rankness. Careful watch was therefore kept to see under what circumstances success and failure were respectively obtained.

Tomatoes set out in borders which have been steamed soon begin to grow very vigorously, and develop a good system of very white and clean fibrous roots, in marked contrast to the brown, knotted roots in houses where "sick" soil occurs. In the early stages plants often do very considerably better than in "sick" soil, and almost always form large dark green leaves and stout stems. The grower does not particularly desire this vigorous growth; he wants early and copious fruit rather than big leaves and stems. Two distinct stages, in fact, are noticeable in the life of the tomato plant: the first leading up to the "setting" of the fruit, and the second to the swelling or growth of the fruit.

Very little is known about the causes that determine "setting," but the grower has learnt by experience that vigorous growth is not particularly favourable, and may be detrimental. Some anxiety was therefore felt when the young plants began to grow very vigorously, and in some cases the anxiety was justified, because setting was actually bad in certain houses.

Good setting was observed when the following treatment was adopted throughout the stage from planting out to setting of fruit:—

(a) When water had been withheld from the roots till the plants were almost on the point of suffering—as the grower picturesquely puts it, till the plants cried for it.*

(b) When no nitrogenous manure had been supplied;

(c) When a brisk heat had been kept up.

These observations are in accordance with the experience of Mr. Dyke, who has given this aspect of the subject very close attention, and has done as much as anyone in applying partial sterilisation methods to glasshouse work.

On the other hand, bad results have followed the use of too much water, the addition of hoof, or the adoption of cool treatment to check growth. The varieties of tomatoes differ; those like Fillbasket that are adapted to rich soils suffer less from rankness than certain others. Again, the size of the plant at the time of planting out is apparently an important factor, a well-advanced plant being less liable to grow rank than a young plant.

The observations suffice to show that rankness is not a necessary accompaniment of steaming, and that good setting can be obtained when the proper conditions are maintained, even with strongly-growing plants.

Another test of rankness is susceptibility to disease; this is an important factor, because no nursery can hope to go scathless through the season. It is difficult to give quantitative data, but the results this season indicate that plants grown in steamed soil are certainly not more, and are probably less, susceptible to disease than those on untreated soil.

OUTDOOR EXPERIMENTS.

Some experiments have now been started to ascertain whether similar results could also be obtained in the field, or whether any new complicating factor comes into play. Once this important point is settled, the only problem remaining would be to find some partial sterilisation method cheap enough for use in practice, and this would merely be a matter of time if the reduction in cost already begun in the Lea Valley continued much further. It is probable that potato growers would be the first to be interested in the method, but potatoes have not been included in these experiments owing to their unsuitability for small plots; cereals have been used instead.

The heating methods are apparently out of the question in this country, although, as Mr. and Mrs. Howard have shown, tropical sunshine can be used in India. These experiments have therefore been made with chemical antiseptics, and the object was to determine whether crop increases could be obtained in the field similar to those in the laboratory; questions of cost or convenience have not yet been considered. The method has been to inject the antiseptic six inches into the soil by means of a hand injector such as is used in Continental vineyards, the holes being ten inches apart each way.

* Recourse may be had to damping overhead in sunny weather in order to keep the atmosphere moist.

The great difficulty experienced has been to make the distribution at all efficient, and to make the injections at the right time; if they were made too early the ground was usually so wet that the antiseptic vapours could not penetrate the water films and get to the particles; if, on the other hand, they were postponed till the ground was drier there was insufficient time for the antiseptic completely to disppear before sowing. These mechanical difficulties have not yet been overcome, and in the outdoor experiments antiseptics have failed to produce consistent and regular increases in crop.—Journal of the Board of Agriculture.

NOTE OF AN ILLIPE OF TONKIN.

In the March-April number of the Bulletin Economique de l' Indo-Chine, M. Ch. Lemarie describes a new Illipe, approaching in its calyx most closely to *Bassia butyracea* Roxb.

The Annamites round Dolen collect the seeds under the trees, and extract from them an oil, used both as a comestible and as an illuminant.

This tree was reported in 1910, from the Annamite province Thank-hoa and from several places in Tonkin: the export of the oil in 1912 reached nearly 100 tons.

A chemical analysis of the seed was carried out in the laboratory of the Services Agricoles of Cochin China: this showed that, of the seed, 14·25 per cent. was shell, and 85·75 per cent. was kernel. The kernel contained 30·21 per cent of fatty matter.

An analysis made at the Jardin Colonial, Nogent-sur Marne, showed that the average weight of one seed was 0·835 grams (1,000 seeds weigh 1·84 lb.) of which 10 per cent. was shell and 90 per cent. kernel: the kernel contained 29·04 per cent. of fatty matter.

The fatty substance obtained was a viscous oil of yellow colour, solidifying about 4°.5 C. This extremely low solidification point distinguishes it sharply from the oils obtained from other species of *Bassia*.

EXPERIMENTATION VERSUS DEMONSTRATION.

Now and then we run across an article in a publication which, criticizing the work of the Government institutions pertaining to agriculture, maintains that much of the research work should be abandoned as unnecessary and more emphasis laid upon demonstration and extension work. As a matter of fact there is more need of research work, whether of a technical or practical nature, in tropical agriculture than in this profession anywhere else, and demonstration and extension work must necessarily be based upon the data obtained by the experimenter. It is only by the patient and close study of a certain species, its peculiarities and response to certain climatic and soil conditions, various modes of culture, or certain methods of propagation, that these peculiarities can be taken advantage of and turned to profitable account for the benefit of the planter. Obviously then, not until better cultural methods for a certain crop, for instance, have been worked out experimentally can demonstration work be effective or, in fact, be in order. Nor can the propagation of a certain species by means of a certain method, such as shield budding, hardwood or root cuttings or layering, be recommended or demonstrated to the planter until its possibility and practicability have been ascertained.—Philippine Agricultural Review.

APICULTURE.

BEE KEEPING IN CEYLON.

A. P. GOONATILLAKE.

A hive must be so made as to protect its inmates from damp and excessive heat. The entrance should not be much larger than is necessary to admit its inmates easily as by that means the entrance of the larger enemies of the bee into the hive is prevented. The inner surface of the hive should have no cracks, crevices or sawcuts in which the bee moth may take refuge or where the bee cannot get at it. It should be made to expand or contract as the occasion requires ; for this purpose a dummy made in the shape of a frame is the best. The bottom board and the roof should be made so that they can be removed without jarring the hive, as also the frames. With a hive of this description every comb can be examined at will without disturbing the bees and closed again easily. All hives, frames and dummies must be of equal dimensions and removable; this helps the bee-keeper to interchange all the combs in every hive in the apiary. There are two kinds of hives, one invented by Langstroth and the other by Danzenbaker. The former's frames are shouldered on the top bar, which enables the bee-keeper to hang them in the hive on rabbets fixed on the top inside of the hive. The latter's frames are placed on rabbets fastened to the inside middle of the hive with the help of two nails fixed on to the extreme middle of the outer side of the side bars and the frames are hence shoulderless and reversible. The Langstroth hive is no doubt easier to manipulate, but I prefer the latter for the simple reason that its frames are reversible. I do not wish to commit myself by detailing the size of the hive for *Apis Indica* because almost all the members of the Bee Committee adhere to one size and I alone to a smaller size. I have seen several simple and cheap hives (mostly made by the bee-keepers themselves) in use amongst the villagers, which simply help them to keep a swarm in, but without any of the advantages of the frame hive, for the bees build more than one comb in each frame. The advantages of keeping bees in frame hives are many, chief of which is the use of the honey extracting machine (now at the Government Stock Garden). As a material for hives anything is good enough, from packing cases to the best timber. If made with cheap material, the outside of the hive should be painted white and the hive kept in a shed, or an extra roof made of painted tin or cloth should be used, otherwise the bee-keeper may not be able to make use of it for more than about two years at the most. Hives made of teak and painted white will last longer (I have hives made of teak eight years ago and they are as good as new to-day). When frames are put into the hive there should be bee-space $\frac{1}{6}$ of an inch between the bottom board and the lower outside of the bottom bar of the frame. There should also be similar bee-space between the surface of the hive roof. The hive entrance should be made in such a way as to expand or contract whenever

necessary. Two handles on either side of the hive will help the bee-keeper to carry it when necessary. Four hooks fixed on to the two sides of the bottom board and four rings on to the lower outside of the hive will keep the two in contact. Glass panes on the sides of the hive should be avoided.

The outer dimensions of every frame in all the hives in the apiary must be of equal size, and when the frames are put in the hive lengthwise there should be bee-space as above described on either side of the frames; in short bee-space should be allowed on all sides of the frames (barring the dummy). The breadth of the top and bottom bar of the frame should be $\frac{5}{8}$ of an inch and the side bars should be $1\frac{1}{8}$ of an inch in breadth, the inside of the frame bars should not be planed and the thickness of them should be $\frac{1}{4}$ of an inch or little less. The side bars should be dovetailed and the top and bottom bars fixed if necessary with wire nails. Care should be taken not to allow cracks, crevices or sawcuts in frames as in the hives. Frames when put in the hive should be parallel and equidistant. To make manipulation easier a beginner should fix two rings or nails one on either top end of the top bar if he uses the Danzenbaker frames.

The super is a hive made for the special purpose of getting the bees to store honey only. It should be of the same dimensions as the hive proper with shallow body if the bee-keeper desires to produce section or comb honey. The frames should be made to fit the super with all-round bee space as described before, but if sections are used there should be a thin strip of wood and also a separator for each line of sections. The strip of wood should be about $\frac{1}{8}$ of an inch thick and one inch broad and about $\frac{1}{4}$ of an inch shorter than the inside of the super. A separator may be made with a similar thin piece of wood of about $3\frac{3}{4}$ inch breadth and $\frac{1}{8}$ of an inch thickness with about six beeways cut lengthwise and the cuts should be all parallel to each other. This separator is intended for the bee-keeper who uses plain sections, but if he uses beeway sections, the separators should be $4\frac{1}{4}$ inch broad. Also if beeway sections are used separators may be made of perforated zinc. If section honey is produced sections may be imported from America or Australia. The hive I use enables me to use it in place of a super.

The nucleus hive is necessary for a bee-keeper if he chooses to breed queens. It is made to hold only two or three ordinary frames, so it should be of the same length but only about a quarter in breadth of an ordinary hive. By placing three dummies in an ordinary hive at equal distances four nuclei could be made with four entrances on the four sides of the hive. If nuclei are made in this way the entrances should be not more than half an inch long. Four strips of canvas to cover the top side of each compartment (nucleus) should be made to prevent confusion of bees when examined. The bottom board may be fixed to the nucleus with the roof removable.

A pair of gloves may be used by the bee-keeper if he is a beginner or at all timid. These may be made of heavy drilling soaked in linseed oil several times. The tip of the thumb and forefinger should be cut and sewed to prevent expansion and allow free use of both.

A beginner may use a veil to great advantage. It may be made of mosquito netting with a facing of black silk tulle net sewed to prevent the

obstruction of his vision. The top of the veil should be gathered with a tape or better still a rubber cord to fit round the crown of the hat. This safeguards the bee-keeper from stings if it does not touch the face or neck. The bottom of the veil if gathered with another rubber cord will facilitate its being tightened below the shoulder, or it may be fastened to the coat or shirt with pins.

It is not with the rifle, sword or bomb shell that we can frighten an army of bees and make them retreat, nor could we command influence over them with an elephant hook or drive them with a stick or whip. You may crush or burn them with fire by thousands, yet the death agonies of their comrades seem to provoke them into renewed fury. It is only with smoke that you can frighten them. It puzzles one to see them retreat in disorder and indescribable fright before a puff of smoke. For this purpose a bee-keeper should keep a bellows smoker handy ; the make of it can not be described here economically but I would advise the bee-keepers to get them from Messrs. A. I. Root Company of Medina, Ohio, as also the gloves and veil at a nominal cost.

Comb foundation of *Apis Indica* (the indigenous bee) could be procured locally on application to Mr. C. Drieberg, the energetic Secretary of the Ceylon Agricultural Society. Foundation is essential to enable the bee-keeper to get his combs built straight ; also it hastens the work of the bees and saves 16 or 20 lb. of honey for every pound of comb. One must have comb foundation if he wishes to produce section honey. Foundation if used in ordinary frames should be fixed straight on to the extreme inside middle of the top bar, if in sections also it should be fixed on to the inside middle and given to the bees. This helps the bees to draw out the comb expeditiously. In using foundation for sections one can be certain of his bees building only one comb in each section. Without foundation the bees build more than one comb because the imported section is broad enough for them to do so as they wish. If one is anxious to produce section honey and cannot procure foundation empty comb should be fixed on to the sections.

Having these appliances at hand I imagine that nobody's attempt at bee-keeping will end in failure. A hive, super, frames and nucleus could be ordered through Mr. C. Drieberg and the rest from Messrs. A. I. Root Company in America. The easiest method of capturing a swarm of bees may be understood by going through my previous contributions carefully.

ENTOMOLOGY.

"RED SLUG" OF TEA.

(HETERUSIA CINGALA—MOORE.)

Though this caterpillar is spoken of as "Red Slug" it is not a 'slug' in the sense that 'nettle grubs' are "slugs;" these have no prolegs on the abdomen, only sticky areas.

"Red Slug," on the other hand has, besides well-developed thoracic legs, four pairs of abdominal prolegs and a pair of anal prolegs. It belongs to the Zygaenidæ among moths, and the imago is a butterfly-like, diurnal moth, *Heterusia Cingala*, MOORE, by name.

It is widely distributed in the tea districts of Ceylon and periodically does a great deal of injury. It is recorded in Ceylon from Madulsima, Kotagala, Nawalapitiya, Koslande, Galaha, Talawakele, Dikoya, Undugoda, Matale, Madulkelle, Kegalle, Pussellawa, Ukuwela, Kalutara, Lunugala, Bogawantalawa, Maskeliya, Gampola, Yatiyantota, Gonakele, Rangala, Kelani Valley, Peradeniya, Avisawella, Badulla, Neboda, Bandarawela, Udapussellawa, Passara. All our records are of damage to tea but MOORE states that it feeds on Lagerstroemia, etc.

GREEN states that the eggs are "narrow, elongate and very pale." Speaking of a closely allied Indian moth, MANN and ANTRAM remark that the eggs are laid in heaps on the underside of old leaves, or on the main trunk and larger branches of tea bushes, being stuck on by a sticky substance. They also state that in May and June the eggs hatch in from 8 to 12 days.

The caterpillar of the Ceylon moth is about 1 inch long when the head is retracted. It is brownish-orange in colour and somewhat translucent; the brown colour is predominant on the dorsum, the orange on the venter. Three longitudinal rows of hair-bearing tubercles occur on each side, one on dorsum, one just dorsad of the spiracles, and one ventrad of the spiracles. From at least the two rows first mentioned a clear drop of liquid is ejected when the caterpillar is molested. This fluid can be drawn out into threads. The hairs do not possess nettling properties. There is also a row of tubercles just dorsad of the prolegs.

The spiracles are black in colour and circular in shape. The whole body is softly hairy, except the head which is smooth. On each abdominal segment between the dorsal and supra-spiracular rows of tubercles there is a faint light coloured spot. The hooks of the prolegs are in a longitudinal band, gradually becoming shorter towards the ends of the bands.

In India it is the habit of the caterpillars to feed in the morning and evening, often leaving the plants in the heat of the day. The length of the larval life is about 5 weeks (MANN and ANTRAM).

In captivity the cocoon is formed in the fold of a leaf. It is of a white or brownish-white colour, firm but not tough, being easily torn.

The pupa is soft, curved and of a yellowish-brown colour, the brown being most distinct in the region of the head, thorax and wing-sheaths.

The abdomen is whitish and is crossed dorsally by brown bands arranged segmentally. These bands bear numerous, short, sharply-pointed tubercles The rest of the dorsum of the abdomen is also provided with tubercles but more sparingly. The apex of the abdomen is blunt and there is no cremaster.

The sheaths of the antennæ and of the hind wings reach to the sixth or even to the seventh abdominal segment, the proboscis sheath to the fourth segment. The antennal sheaths are quite free at the tip.

In India the cocoons are also located in the fork of a branch. The imago emerges in 20 days (Green) in from 17 to 21 days (Mann and Antram): the pupal case lies free after emergence. In India it is the habit of the moth to rest on stems in the hot part of the day, and swarm round trees in the afternoon and early evening ; at such times large numbers can be destroyed.

Moore describes the Ceylon species in the following terms :—

" Male and female : forewing dark sap green, with a broad, basal, whitish, blue-bordered band, crossed by a blackish-green streak ; a discal zigzag series of yellowish spots, and a larger spot at end of the cell ; hind wing with the base and a broad outer band black, the veins and marginal border steel-blue ; a series of yellowish spots before the apex, which are indistinct in the male ; middle band pale yellow. Thorax and base of abdomen in male steel-blue, lower part of abdomen yellow, tip black ; antennæ black, shaft steel-blue, Underside with veins blue lined. Expanse male 2, female $2\frac{1}{2}$ inches."

One frequently finds attached to the larva, especially in the intersegmental folds of the dorsum, small, oval, white bodies. These are the eggs of a parasite belonging to the Tachinidae. Flies of this group resemble house-flies, but they may be told by the facts that the arista on the antenna is bare, and that the apex of the abdomen bears stout bristles. They make a peculiar hum, too, especially when caterpillars are about, that is characteristic.

Their larvæ are internal parasites of insects, especially of lepidopterous larvæ. The female fly sometimes lays her eggs on the host (as in the case of *Heterusia Cingala*), sometimes she lays them on the leaves, to be engulfed by the caterpillar.

Where such eggs are common on caterpillars it will be wise to leave Nature to do the work of control.

A. RUTHERFORD.

INSECTS DESTRUCTIVE TO DADAP.

(ERYTHRINA SP.)

Dadap suffers chiefly through being defoliated by caterpillars. The most important of these are shortly described below. They can be controlled by an application of arsenate of lead to the foliage.

TARAGAMA DORSALIS, WLK.

Caterpillars of this moth were received in November 1913 with the report that they were eating down the dadaps and that, after the dadaps had

been pollarded, they had stripped a few hundred tea bushes. We have records from Albizzia as well as from dadap and tea.

The caterpillar is fully 2½ inches long and flattened on the venter. The head bears long, white, drooping hair. The antennæ are whitish at the base and the labrum is deeply cleft. The general colour is greyish-black. The second and third thoracic segments bear large, black, dorsal tufts of hair, that on the third segment with brownish hair on its caudal margin. There are lateral tubercles bearing tufts of greyish hair ; the tubercles on the first, second and third thoracic segments project, and that on the first thoracic segment is bilobed. The thoracic legs are brownish.

On the dorsum of the abdomen are small tubercles which bear short spines. The tubercles on the eighth abdominal segment are rather more conspicuous. The venter is brownish, with black areas and an oval, yellowish spot on each abdominal segment. The hooks of the prolegs are in a longitudinal row and are of two lengths alternately longer and shorter. The anal prolegs are broad.

Numerous eggs, presumably those of this moth, were present on the leaves. They are broadly oval, almost globular, whitish with purple spots. The largest spots are at one end and are grouped round a circular purplish spot at the pole.

The cocoon is of firm texture, brownish-white and shining. In captivity it was formed on the wall of the breeding cage. The pupa is of a dark brown colour and is covered with short, brown hair : encircling the abdomen intersegmentally are three very distinct light-brown bands.

From a cocoon formed on November 18th a moth emerged on December 5th. This moth was a female and measured 63 m.m. in wing expanse.

Hampson describes the moth as follows :—

"*Male.* Expanse 54 m.m. Antennæ fulvous ; head, collar and thorax greyish-white ; tegulæ deep red-brown ; abdomen red-brown, each segment fringed with grey. Forewing deep red-brown ; a white spot at base ; one on costa just beyond the middle forming part of an almost obsolete medial line ; a waved post-medial oblique white line, obsolescent at middle ; margins narrowly white.

Hind wing deep red-brown, with a large white patch at the anal angle ; outer margin narrowly white.

Female. 80—102 m.m. in wing expanse. The pale fringe to the abdominal segments broader ; hind wing paler with the pale patch produced across the wing as an indistinct band. Distribution.—N. W. Himalayas, Calcutta, South India, Ceylon, Philippines, Borneo and Java."

EUPTEROTE GEMINATA, WLK.

A correspondent recently wrote of this insect, "It is becoming a nuisance and causing considerable damage."

The caterpillars when about 1 inch long have a reddish-brown head with yellow and black markings on it ; two black spots on the vertex surrounded by a yellow area are conspicuous. The ocelli are situated in a black area. There is a broad, longitudinal, pinkish-white dorsal stripe ; this includes three distinct narrow whitish bands.

Laterad of the dorsal stripe is a black stripe with a narrow light bluish stripe on its mesal margin and a broad bluish band on its lateral margin; this last mentioned band contains a narrow, white, longitudinal stripe and a series of black spots besides numerous, irregularly placed, smaller black spots. Caudad of each spiracle is a reddish-brown spot and ventrad of the spiracles a yellowish, longitudinal stripe.

The prolegs are pinkish with yellow extremities. The hooks of the prolegs are of two lengths and are arranged in a longitudinal, curved row on the inner side.

The body is provided with long, white, black-tipped hairs in tufts; also with tubercles bearing short stiff hairs which may break off and pierce one's hand. In addition there is a fine covering of short secondary hair. On the ventral surface is a yellowish stripe bordered by a black band.

The caterpillars make a slow growth. When about $1\frac{1}{4}$ inches long the dorsal stripe is less distinct especially on the abdomen, and the abdominal segments bear dense tufts of grey silky hair. Supra and infra-spiracular yellowish stripes are still present, also the brown spot caudad of each spiracle. The prolegs bear two yellow stripes running from base to apex on the outer side. At the caudal end is a brilliantly coloured spot reddish-brown dorsally and yellowish ventrally.

Caterpillars which were one inch long on November 20th, and $1\frac{1}{4}$ inch long on December 19th were beginning to spin cocoons on January 8th and from these moths began to emerge on February 21st. The cocoons are composed of cast hair and are coated with the sand that lay in the bottom of the breeding cage. The pupa is about $\frac{1}{2}$ inch long, light-brown at first, later chestnut-brown. The cremaster is comparatively long and slender with numerous small hooks round the tip.

The moth is orange-yellow in colour. In the male the forewing has a faint transverse band near its middle and a firm, curved, transverse band nearer the apex. There are two more or less distinct black spots near the apical angle and two or three near the anal angle. The hind wing has a black, transverse band near the apex of the wing, a faint medial band and two faint black spots near the anal angle. Expanse 58 m.m.

The female is darker in colour and the markings are as in the male, but the band near the middle of the wing is less distinct in the front wing and absent in the hind wing and there are no spots on the hind wing and only two faint anal ones on the forewing. Expanse 66—80 m.m.

Eggs laid in the cage are yellowish-white, slightly depressed and with a darker spot at one pole, shining on one side and dull on the other. They hatched in about 15 days. Hampson gives the distribution as N. India, Camara and Ceylon.

We have records of the caterpillar feeding on grass, tea, cotton, Hibiscus sp. and Castilloa elastica.

EUPTEROTE FABIA, CRAM.

I found a large cluster of caterpillars, probably of *E. fabia*, at the base of a dadap. They were moulting. Most of them had their heads directed towards the centre of the group.

The caterpillars are greyish-black in colour and are covered with long, greyish hair white at the tip and arranged in tufts.

The head is reddish-brown with two very dark brown areas on the vertex; dorsad of them in the middle line is a rectangular, light-brown area and ventrad of them in the middle line is a triangular, yellowish-white area. The clypeus is whitish-yellow, the labrum deeply notched, the notch with a yellow edge. The basal segment of the antenna is whitish-yellow, the terminal brown.

The hooks of the prolegs are in a curved, longitudinal band on the inner side and are in two series. The venter is black.

Later a few, short, reddish-brown hairs appear caudad of the dorsal tubercles on the abdominal segments one to seven. Three longitudinal, dorsal, whitish bands separated by black bands are more or less distinct. The hair-bearing tubercles occur on the thoracic as well as the abdominal segments. Each tubercle bears short, stiff, sharply-pointed hairs as well as long hairs. (The silky hair of *E. geminata* is absent).

On the neighbouring tree was what was probably the remains of a former cluster. In this case everyone had been parasitised by a (Tachinid?). The puparium remained within the much-contracted larval skin.

I have seen a similar caterpillar clustered at the base of the stem of a Sapu. This habit can be taken advantage of to their undoing.

In this insect, as in the case of *Eupterote geminata*, growth takes place very slowly.

ORGYIA POSTICA, WLK.

The caterpillar of this moth has been recorded as feeding on Eucalyptus sp., Velvet Bean, Tea and Albizzia in Ceylon; in India it feeds on Castor.

The caterpillars (about 1 inch long) are brownish in colour, with yellow hairs rising from yellowish tubercles. The head is reddish, the antennæ white. On the thorax and less distinctly from the fifth abdominal segment towards the posterior end are two yellow stripes. Short, oblique, yellow bands occur on the sides of the abdomen. From the sides of the first and second abdominal segments extend laterally pencils of yellow hair.

Dense brownish-yellow tufts rise dorsally from the first, second, third and fourth abdominal segments. Two long pencils of black plumed hairs extend forward and outwards from the first thoracic segment, and a pencil of brownish hairs reaches upwards and backwards from the eighth abdominal segment. From the ninth and tenth abdominal segments long brown hairs extend backwards in four bunches. Circular, concave purplish glands are situated on the dorsum of abdominal segments six and seven.

The ventral surface is greenish-yellow. The thoracic legs are brownish and the prolegs, which are of the usual number, bear their hooks in a longitudinal row.

The eggs of a Tachinid are sometimes to be found on the dorsum. The cocoon is formed of silk and the hairs of the caterpillar. The pupa is yellowish-white. From cocoons being spun on November 8th adults were emerging on the 13th.

The female moth has rudimentary wings only and clings to its cocoon where it deposits its eggs. The body is brownish-white and bears blackish hairs; the hairs are most abundant at the posterior end where they form four distinct fringes. The eggs are white, shining, cup-shaped, what corresponds to the mouth of the cup being covered by a thin membrane.

The male is winged. The head, thorax and abdomen are greyish-brown. The forewing is greyish-brown with an indistinct, oblique, sub-basal line; waved ante-medial and post-medial black lines which converge near the middle of the wing enclosing an area that is tinged with bluish-grey and contains two short, black lines edged with white. There are two indistinct, waved sub-marginal lines. The apex of the wing is slightly tinged with grey and bears some sub-apical black streaks. The hind wings are dark-brown. The wing expanse is 24-28 m.m. Hampson gives its distribution as Sikhim, Nagas, Formosa, Nilgiris, Ceylon, Burmah, Borneo, Java, New Guinea.

The caterpillar to be next described bores from the ends of the twigs downwards. It is the larva of a Pyralid moth, *Terastia meticulosalis*, Guen. In colour it is white with a pinkish tinge on the dorsum. The head, prothoracic shield and tubercles are black. The anal plate is slightly chitinised and spotted with brown.

A pupa was found in a tunnel. It is brownish and the proboscis sheath reaches to the level of the fourth abdominal spiracle. The tunnel in the region where the pupa lay had a coating of fine, brownish silk and the cavity was closed below and partly closed above.

[Twigs of Red Toona (*Cedrela toona*) sent in on one occasion along with those of dadap were attacked in the same way. The caterpillar was of a bluish-pink colour but otherwise resembled that in dadap. It was about to pupate. An exit hole had been formed and covered over with a mixture of silk and frass. Just outside this hole the bark was eaten].

The imago of *Terastia meticulosalis* is of a pale-fawn colour. The caudal and inner edges of the front wing are wavy. The front wing is of a greyish-brown colour with several hyaline areas, two of which, separated by a dark, obliquely-transverse band, are distinct; a third hyaline area is situated at the apical angle of the wing and is bounded by a dusky area. The hind wing is whitish with the costal and caudal margins brownish. Expanse 38 m.m.

Hampson gives the distribution as St. Domingo, Honduras, Ceylon, Java and Philippines.

Sometimes another Lepidopterous larva is present in the finer twigs. I have not reared the adult. The pupa bears two curious, short processes projecting cephalad from the dorsum of the head region just caudad of the antennæ. At the posterior end of the body is a short, slightly-chitinised projection bearing four processes the middle two being the longest and these curved and sharp at the tip.

If it is desired to get rid of these pests the affected twigs should be cut back until the end of the gallery is reached, collected and burned.

CYCLOPELTA SICCIFOLIA, WESTW.

C. siccifolia is a *Pentatomid* bug whose habit it is to feed in massed colonies on the twigs. It is a sucking insect and the twig at the point of attack may shew a withered appearance. The adult is about 7/12 inch long and is of a very dark brownish-black colour, except the membraneous parts of the front wings which are of a lighter brown colour.

The nymphs are very different in colour from the adults, being as a whole much lighter.

The thorax, middle of the scutellum and wing cases are brown. The head, antennæ, distal part of legs, an area on the dorsum of the prothorax, the scutellum laterally, and six longitudinal bands on the abdomen are black. The black bands on the abdomen are separated by orange-coloured bands and each abdominal segment bears on its margin a white spot.

The mid-dorsal black band which is comparatively broad bears several orange-coloured spots, several of them on tubercles. The legs proximally and the rostrum are reddish-brown. The thorax and wing cases have a narrow black edging. When disturbed the insects eject from the anus a fine stream of liquid, which, if it fall on the skin, produces a smarting sensation.

The insects have a strong pungent odour. The eggs are placed in longitudinal rows on the branches. Colonies of adults of this bug have recently been found on Cacao. Distant gives the distribution as Sikhim, Khasi Hills, Bengal, Bombay, Poona, Vizagapatam, Ceylon, Burma.

Their habit of feeding in colonies renders their destruction easy.

A. RUTHERFORD.

PROGRESS REPORT OF THE DRY ZONE EXPERIMENT STATION, ANURADHAPURA.

From April 20th to June 20th, 1914.

The 14 acres of land at the southern end of the "station" is now free from stumps, and the surface of the land has been very fairly levelled, by the removal of ant hills and the filling up of depressions.

The land is being irrigated and will be shallow ploughed, so as to bring up any surface roots which may be present in the soil.

Our main irrigation channel—bed width 2 feet and average depth of 3 feet 6 inches—has been cut to a distance of close upon 1,000 feet. As regards fencing, 600 yards along the roadside boundary have been completed, that is to say a jungle post and 6 strands of barbed wire fence.

With the erection of a similar run of Colonial iron standard fencing, the fencing of the roadside boundary as at present defined, will be completed. The railway side boundary is now being fenced and some 250 yards are in course of erection, i.e., a wood post and barbed wire fence.

I am now engaged in clearing the remaining 35 acres of jungle lying between the road and railway. Some 12 acres of jungle have been felled to date.

G. HARBORD.

CO-OPERATIVE CREDIT MOVEMENT.

CO-OPERATIVE DAIRYING.

The application of the co-operative principle to dairying appears to have given encouraging results in the United Provinces of India after a trial of $2\frac{1}{2}$ years.

The Society buys milk at 10 seers for the rupee from its Members, and disposes of it to the public at 8 seers for the rupee, at which price it meets with a ready sale. The milk is drawn from a distance of four or five miles and is available at five depots in the City of Benares.

The dairy has so far not been able to do more than pay its way on account of the cost of transport which is slow and expensive, as well as owing to the fact that the difference between the purchase and sale price is not large enough. Even if prices cannot be adjusted to satisfaction, it should be possible to introduce quick means of transport and tap cheaper sources of supply from still further afield, so that a larger output, with proportionately better returns, could be secured.

The experiment is one well worth the attention of our local Societies in districts offering grazing and other facilities but lacking the necessary market, which could however be secured by quick transport either by rail (where such is available) or other means.

In places where milk is cheap but the distance for a market centre makes it impossible to deliver it in good condition, it should be possible to "separate" it and send down the cream to be converted into butter in a central factory. This has been done in some places in the Bombay Presidency with buffalo milk which in India is considered the best for butter-making ; but with us (for some sentimental reason) buffalo milk and butter are not appreciated.

C. D.

CO-OPERATION IN BENGAL.

Mr. S. Bradley-Birt, I.C.S., Collector of Midnapore, opened the fourth session of the Midnapore District Co-operative Conference, which met at Bayley Hall, under the Presidency of the Hon'ble Mr. Byomkesh Chakravarti, Barrister-at-Law.

Mr. Bradley-Birt, in opening the Conference, welcomed the delegates, and, reviewing the gradual growth of the co-operative movement, said :—

The co-operative credit system is a thing of recent growth in the province, so recent that although Midnapore was one of the first districts to take it up, it was only some nine years ago that the first Co-operative Society was

formed in the district—the Balrampur Society which was registered in May, 1905. So rapid, however, has been the progress of the movement, that there are now 152 Societies with a membership of over 6,000 and a working capital of nearly two lakhs of rupees. Most of these Societies are to be found in three areas of the district—in Kelar, in Belaberia and in Pingla.

Continuing, Mr. Bradley-Birt said :—Outside these three areas there are now four Societies in the Contal Sub-division, two of them recently started. In Ghatal there are at present only a few societies which have not yet made all the progress that we could have hoped.

Dwelling on the organisation of co-operative societies in rural areas, he pointed out :—With the object of organising fresh societies of supervising them, and where necessary of financing them, local banking unions were formed, the various societies within their sphere of influence being the shareholders.

Referring to the Midnapore Co-operative Central Bank, he said :—The capital of the bank at the present moment consists of some Rs. 70,000 deposited by private individuals and Rs. 18,000 in shares, only two calls of Rs. 10 each having as yet been made on the shareholders. The bank pays 6 per cent. on deposits, lending out to the union banks at $7\frac{1}{2}$ per cent. and to individual societies at $9\frac{3}{8}$ per cent.

Alluding to the difficulties of the movement Mr. Bradley-Birt pointed out that two of the greatest handicaps to the co-operative movement in the province were the ignorance of the people, the agricultural classes, and secondly, the lack of interest on the part of those who could, if they would, do so much to make it a success.

Continuing, he said :—Those of you who know the district as well as I do—and there are many of you here who know portions of it far better—will realise under how heavy a handicap the cultivator lies. Always in debt, and often so deeply in debt at exorbitant rates of interest, that by no conceivable chance can he ever hope to escape from it : he is robbed of all incentive to strive after better things. There can be little improvement in the condition of the labourer and in agriculture generally while such indebtedness remains. It is to fight this great evil that the co-operative credit system has been planned, and gradually the cultivator is beginning to grasp all the possibilities that it opens out to him. With loans available at a reasonable rate of interest, he can hope in time to pay off his debts and improve his holding.

PRESIDENT'S ADDRESS.

Mr. Chakravarti gave his address in Bengali. He thanked the members for doing him the honour of selecting him as their President. Referring to the history of the country, he said that there were in days gone by village societies and unions in parts of Bengal, Bihar and Orissa. From the Buddhistic period many examples are found of the existence of such village guilds which used to decide disputes, punish breach of contract, and turn out from villages the wanton breakers of lawful customs. Reports are also found that these *samities* kept the deposits of villagers and paid them 5 per cent. as interest. Even at the present day relics of such village unions are to be found in parts of Bombay, Guzerat, North and Central India. But alas ! in Bengal there are now no signs left of these institutions. Thanks to the initiative and

help of Government, the people now find an indication of their revival. The government of the country have done much in the last decade to establish and extend the co-operative societies. Their success and further extension depend on the general public. The present population of Bengal is about 45 millions, of which 75 per cent. are agriculturists. Only $3\frac{1}{2}$ lakhs are artisans and traders, 3 lakhs are service holders, and 8 lakhs carry on independent professions. Thirty-six per cent. of the people of the country only work and remaining 64 per cent. are independent of the former. If the internal condition of the country is considered, it is found that prices of articles have risen. This rise in prices has now become a normal thing and those who have profited by it the most, i.e., the producers or the agriculturists, are as a rule improvident and spendthrift, and the middle-classes who are the victims of high prices are half starved and reduced to penury. That is not all. Those who know the internal condition of the people are fully aware of the misery which the people suffer through oppression of the money lenders. The solution of the problem has now been found in the system of co-operative societies, the object of which is to improve the condition of the members by means of co-operation and by encouraging thrift and self-help. This will certainly increase the national wealth of the country.

There were village communities which previously performed all these functions, but in course of time the bond has been slackened and there are now disputes, litigation, and village factions everywhere in place of the peaceful life of old days. The people should now be determined to revive the old village community.

Mr. Chakravarti then shortly described the different functions which were performed by co-operative societies in the matter of grant of loans, acceptance of outside capital, saving deposits of members, and so forth. He dwelt on the moral and social effect of co-operative credit societies. He said that it could not be gainsaid that these societies strengthened the character of members, stimulated corporate action in directions other than credit, and induced a wider outlook on life.

He then said that the district of Midnapore was the pioneer in the field of co-operation and its example was being followed in other parts of Bengal. He referred to the Resolution of January 13th, 1914, issued by the Government of Bengal. There were in Bengal on June 30th last, 1,121 societies with a membership of about 57,000 and working capital amounting to 46 lakhs. Then he referred to the valuable services rendered by his own countryman (Mr. Jamini Mohan Mitra), the present Registrar, to whose energy the success of the co-operative movement in Bengal was due. He expressed his opinion that the duties of guiding and fostering the co-operative movement could be very satisfactorily performed by his own countrymen.

Then he pointed out that agriculturists by getting loans from co-operative societies at fair interest have made a saving of about 20 lakhs of rupees in the matter of payment of interest in comparison with the prevailing rates of interest of local money lenders.

Finally he exhorted the young men to take up the question of introducing these village societies into every village with which they come in contact. That would be doing their duty to their king, the country, and their own religion.—Indian Agriculturist.

POULTRY.

THE REARING OF CHICKENS.

JAMES PLACE.

The rearing of chickens forms one of the hardest tasks with which the novice is confronted, and if he does not look forward with care to fulfil the wants of the little chicks he will soon see that failure will stare him in the face. To rear them successfully he must give them his utmost care and attention, and feed them regularly along scientific lines, and by so doing he will see that rearing chickens is both pleasure and profit. When the chicken has been hatched it requires no food whatever for the first twenty-four hours of its life, and will even go for a period of thirty-six hours with nothing to eat, as Nature has provided it with food in the form of the yolk of an egg, which it absorbs prior to leaving the shell. So the first few feeds afterwards should be made principally of egg mixed with oatmeal. For promoting the growth of a chick there is nothing like the change of food. Start the second day with a feed of chicken meal scalded and allowed to stand until warm. I may here state that there are several good meals on the market for chickens, but buy a good sample, and do not be led off with imitations. I prefer the chickens to have no water at all until ten days old, as it very often causes bowel troubles. Rather they would sip the dew off the grass. The food should be placed on a clean piece of board, and only sufficient given at one meal that they will eat. No food should be left about, or it will become tainted, and diarrhœa will soon set in.

The following foods may be given:—Biscuit-meal, after it has been scalded, should be mixed with oatmeal and middlings, and a little animal food may be given, such as cooked lean meat, chopped fine and given on alternate days at noon after the birds are two weeks old. The meat should be given very sparingly at first, allowing a few picks each, and increase it as the chicks grow older. If there should be any signs whatever of diarrhoea, leave off the animal food and feed largely on the oatmeal mixed with milk. When the chicks have reached a fortnight old the last feed should be given as late as possible. It may consist of broken wheat and small groats. The novice must not feed with the floury groats, as these are not good at all for the young chicks. A liberal supply of finely cut grass should be given to those that are kept in confined runs and have not access to grass. Fine flint grit should be given at this age, and be continued.

When the age of four weeks has been attained the feeding may be reduced to five feeds daily. Now that the chicks are growing and making bone it is essential that they should be fed with plenty of good sound grain, and given as late as possible at night, as this will sustain them much longer than soft food. If the chicks should show any signs of leg weakness a little bone meal will be found beneficial given once a day in their soft food, and also green bones ground very finely should be given regularly as a noon-day feed.

When the birds have reached the age of six or eight weeks the biscuit-meal, in addition to oatmeal and fine middlings, should have a handful or two of pea meal added, but the last meal should always be good sound wheat and groats. When the chickens have reached the age of ten or twelve weeks the cockerels should be separated from the pullets, and the culls weeded out. Both sexes should have a separate run to themselves. Experience tells us that if this plan is adopted the pullets will by all means get on better. Having now separated the sexes and found suitable roosting quarters, the question of perching arises. The growing chick's breast-bone is, naturally, very soft and pliable, therefore the poultry keeper should provide such perches as will not damage the chick's breast-bone during the time it is roosting. The perches should be placed about 18 inches from the ground, or the bird flying down from a higher perch is apt to damage, not only the breast-bone, but the feet as well, and so cause the complaint of bumble foot. Having got the chicks roosting on suitable perches, the soft food may now be reduced a little. The first feed should be biscuit-meal scalded and mixed to a crumbly nature by the addition of equal parts of middlings, pea-meal, and oatmeal. At noon may be given the ordinary feed with a little animal food, finely cut fresh green bones mixed with the soft food. The last two feeds may consist of English wheat, oats, etc., varying the feeds somewhat each time. This system of feeding may be continued until the chicks are about six months old, when they should be showing signs of laying.—Feathered Life.

FOOD AND FEEDING.

There are three essential points in poultry-breeding. They are—Good breeding, common sense housing, and scientific breeding. Various points in connection with housing and breeding are given elsewhere.

As regards choice of foods and methods of feeding I will refer to the methods adopted in handling the competition pens. Only general reference can be made to the science of feeding; space does not permit. I compressed much into a good-sized book, "Poultry Foods and Feeding."

Many people, especially some in England, hold erroneous views as to the feeding methods in egg-laying competitions. I have no first-hand knowledge of what is the practice elsewhere—I read the reports issued. Here in South Australian competitions, since they have been under my direction, nothing in the nature of forcing foods or condiments has been used. The birds are fed on commonsense scientific methods available for commercial conditions. I am always glad when good records result, but I have always set my face against the use of anything which might unduly force egg production. Where a poultry farmer has a flock for the production of market eggs it is his business, if he finds it profitable, to stimulate the birds to the utmost production; here the case is quite different. The birds are held in trust for their owners. At the termination of the test they will probably be used as breeders. Any forcing would seriously damage them for breeding purposes. It must be also remembered that in South Australia wheat and the mill products of wheat, viz., bran and pollard, are our main staples. In the South-East one may with

advantage use the excellent locally grown oats and the mill products of the oats. Barley in any form is not conducive to good laying results. Peas are not always obtainable, nor do the birds always like them. Maize is very dear here, and a little is occasionally used as a change in very cold weather. A good deal of lucerne hay chaff is used, as the food value of this splendid adjunct to the poultry foods has been amply demonstrated. Green feed is fed as much as the birds require. Grit—including shell grit, sharp hard gravel, and charcoal grits—are absolute necessaries, and should always be available in sheltered hoppers. One hears opinions that neither shell grit nor hard quartz grit are necessary. Let these Solons put in a month at Parafield and see the amount consumed. Charcoal grit is particularly valuable on account of its antiseptic qualities. The birds consume a lot, and its cost per bird is inappreciable.

HOW THE BIRDS ARE FED.

Only grain of the best quality, as well as bran and pollard, are used. It is a mistaken policy to buy inferior or damaged foodstuffs. Where standard quality is concerned one may accurately gauge the quantities required and the results to be expected. All foods are purchased at current market rates. No condiments of any sort are used.

Morning. At 7 a.m. the first meal of the day is served out. This is fed in earthenware pans. Never throw mash on the ground. The average proportions of the morning mash are pollard two parts, bran one part by bulk, and lucerne hay chaff. Meat meal at the rate of ¾ lb. per 100 hens is made in soup, which is used for scalding the bran and lucerne chaff. These are then dried off with pollard until a crumbly mass results. Hot soup is only used during cold weather. In the hot months—from September to March—the meal may be mixed with cold water. A handful of salt per 100 hens is added to the liquid used in moistening the mash. The quantity of mash averages from 4 ozs. to 5 ozs. per bird, according to appetite. The food is mixed by hand. I have not yet seen a mechanical mixer that would suit the purpose. A proper consistency of mash is of the utmost importance. Slovenly methods soon tell their tale in the unthrifty appearance of the stock. The exact amount of food required by a pen of birds depends on the circumstances. Observation alone will show this. If the food is not at all eaten, say, within a quarter of an hour, the balance should be removed. Should the birds require more food they should have it. As the yards are floored with straw, in which the grain is scattered, there are no idle moments for hungry fowls. As soon as it is light enough in the morning for the birds to see, they leave their sleeping quarters and are soon busily scratching in the litter for grain left over from the previous day. This exercise promotes digestion and keeps the birds warm in cold weather. When the morning feed arrives they are ready for it, but there is no rushing and excitement.

Noon.—At midday green food, chaffed, is fed at the rate of about 2 ozs. per bird. The amount may be increased so that the birds have as much as they will eat. Green food is of the utmost importance as a food. It has also important functions in assisting various processes of digestion, and reactions on the blood. Grains and seeds generally are deficient in salts and minerals. These valuable food constituents are well represented in green foods. Green

food for poultry should be fresh and succulent. Stale green feed, or old, tough, fibrous growths are of little value, and may even be harmful. For Australian conditions lucerne is the most valuable of all green foods. It grows more readily in most localities, and under good conditions of soil and treatment will give enormous yields. Berseem (Egyptian clover), introduced to this State by the Principal of the Roseworthy College, is a most valuable green fodder for poultry. As a rule lucerne yields little after April. Berseem sown in March and well irrigated will give a succession of cuts yielding enormous quantities of succulent green food highly relished by the birds. With the advent of the warm weather it is advisable to plough in the remains of the berseem, and prepare the ground for other crops. Barley, oats, and rye all make good winter crops, but must be cut young, not when tough and stringy. Kail, including thousand-headed, Jersey tree, and French (*Chou Moellier*) are exceedingly valuable. They should be planted out in rich soil and irrigated. The thick stalks of the French kail are hollowed out by the birds. Silver beet affords a large supply of excellent food in spring and summer and is much appreciated, especially by young stock. Sprouted oats have been tried, but many of the birds did not approve of them. Sprouting grain, i.e., just germinating, contains various proteins of considerable food value, but must be used with discretion. Succulent green food can be grown by most South Australian breeders. If green food is not available, or the supply is short, the birds should have a little grain thrown into the litter at midday. On the whole the system of feeding chaffed green food is preferable to giving it loose as cut from the plot. The birds eat practically all the green chaff. Lucerne hay which has been well made, if chaffed, and scalded, adding a little salt to the water, makes a splendid substitute for green food. All breeders should stock lucerne hay chaff. Our fodder merchants do not stock this valuable food as a rule. If, however, breeders made a persistent demand, no doubt arrangements for regular supplies would be made. One-third of the bulk of a fowl's food may be vegetable—green or cured—and with ducks the proportion may be one-half. Not only are better results obtained, but at a lower cost. Green food and lucerne hay chaff are cheaper than grain and mill by-products.

Evening.—According to the time of the year from 4.30 p. m. to 5 p. m. witnesses the feeding of the third and last meal. This is always in the form of grain, generally wheat. In cold weather peas, maize, and short stout oats may be fed with great advantage. The average quantity is 2 ozs. per hen. The grain should always, as at the poultry station, be well scattered in the scratching litter. This prevents the birds overloading their crops, because they have to scratch and hunt for the grain and eat slowly. As a rule there is enough left in the litter to tempt the birds to early activity next morning. When other grains—oats, peas, maize, etc., and a little barley occasionally—are obtainable at reasonable rates it is policy to feed them, because variety of food is most desirable.

Other Essentials.—I maintain that a good supply of clean scratching litter in the yards, and where possible also in the houses, is the keynote to success. Busy birds are generally healthy, contented, and productive. Birds must have exercise, and they get more under these conditions in small yards than they do where the range is unlimited, but with no scratching litter.

Water.—In cool weather the drinking vessels, after careful cleansing, are filled daily. In hot weather the supply is renewed as required. The point is regarded as of great importance. The body, as well as the egg of a hen, contains a large percentage of water. Fowls require a large amount of water, especially on hot days. Particular attention must be paid to the cleansing of the water vessels. These must be scrubbed, a mere rinse out may leave the trouble behind in the vessel. The water vessels should be shaded from the sun. Sun-heated water leads to trouble.

Grit.—Three kinds are used—hard quartz and shell grit—both of these are much sought after by the birds. The third is charcoal grit. I have used charcoal grit for 30 years, and have advocated its use from the newly-hatched chicks onwards. It is invaluable as an antacid. Where used sickness is rarely encountered. The grit should be kept in a hopper or trough in the house and sheltered from the wet. Wet charcoal loses much of its absorptive power.

Medicating the Water.—Sulphate of iron in the form of Douglas mixture is commonly recommended. One writer after another has copied the instructions, and I also did so no doubt. Some years ago the fact struck me that the amount of iron in the organism is so small that the administration of large quantities was a mistake because beyond an infinitesimal amount none would be absorbed. Then it seemed that organic iron would be far more suitable to use, and I am not convinced at all by those experimenters who claim that inorganic iron is as effective as that of organic origin. Douglas mixture, ferrous sulphate, and sulphuric acid may be used sparingly in either the drinking water or for mixing in the mash. The sulphate of soda and magnesia—Glauber's and Epsom salts—are of very great value for poultry. In both these sulphur is held in chemical combination, but in the system splits up and performs valuable offices. The sodium sulphate (Glauber salts) is more expensive than the Epsom, but it is a more valuable substance. In laying hens the action on the intestines is gentler, and the influence on the oviduct is most beneficial. The blood is alkalinated also. It is a good plan to mix a stock solution, 4 ozs. to one pint of hot water. Of this use a teaspoonful to each quart of drinking water. Epsom salts has its value also, and may occasionally be used. Its use is indicated in hot weather as a cooling agent. One ounce dissolved in the water used for mixing the mash of 20 hens, once a week, is sufficient. These salts are useful in outbreaks of chickenpox. After the morning meal is eaten all pans are cleaned and turned over ready for next day. Great care is exercised in regard to cleanliness. Success in poultry-keeping depends largely upon the power of observation on the part of the attendant. The various processes in connection with feeding should be carried out quickly, but not perfunctorily. A quick glance should note the appearance of each bird at feeding time. A bird "off its feed" needs examination.—D. F. Laurie in the Report of the Parafield Egg-Laying Competitions.

EARLY IDENTIFICATION OF GOOD HENS.

J. WILSON.

An important observation has been recorded in connection with the egg-laying competition at the Munster Institute (Cork). It was found that a hen's total egg yield for the year could be predicted from her performance during the first eight or ten weeks of the laying season (November, December, January). Good layers laid about five eggs a week, very seldom having two successive blank days, and continued at this rate for eight or ten weeks. Medium layers had blanks of several days at a time, or did not give a continuous steady yield during the same eight or ten weeks, while bad layers laid very few or no eggs during the period.—Monthly Bulletin.

REARING DUCKLINGS FOR THE TABLE.

It is rather surprising when one considers the ease with which ducklings can be reared to a profitable age that more poultry-keepers do not take up this branch of work. Ducklings are very much easier to rear than are chickens—they are far less prone to disease, cramp, leg-weakness, or scour, or less apt to suffer from tainted ground, do not become infested with insect pests, and can be far more quickly turned into money. The main object, indeed, in rearing ducklings for the market is to push them on to make as rapid growth as possible, so that they can be marketed and the ground left free for other stock, to say nothing of the saving of food and labour bills thus effected. Stock ducks, of course, and those ducklings which are to be reared for stock, require different conditions from those which are being reared for the table, but where market ducks only are being catered for a very small space of land is required. In the "duck" districts of Bedfordshire and Buckinghamshire, where thousands of ducklings are marketed every year, the same piece of land is used for many seasons in succession, and seemingly with no ill-results. The risks both from overcrowding and tainted ground are much less than in the case of any other feathered stock.

Incubators are increasingly used for duck-rearing, and the sale of day-old and week-old ducklings is rapidly approaching that of day-old chickens.

If ducks are being incubated at home, care should be taken not to remove them from the drying-drawer till they are perfectly dry. If removed when the least damp they are liable to contract chills, and it has to be remembered always when considering the rearing of market birds that any set back in growth or lack of steady progress is bound to affect profits very materially. Ducklings require very little brooding—far less than chickens or turkeys—and in mild weather do much better if taken from the hen at the end of five or six days. They should be placed in large roomy coops without wooden floors, straw or peat moss being placed on the ground beneath the coop. If ducklings are allowed to stand on wooden floors they contract cramp and leg-weakness. As they grow older they may be run in a small, open-fronted shed, across the front of which wire netting is run.

Different rearers advocate different methods of housing, some preferring to keep the birds entirely under cover, others allowing an outer grass run to the sheds. We have always allowed the run to our own birds, and have never had any difficulty in getting them up to good market weight in the time required. It is not, of course, advisable to permit the ducks to take too much exercise, as the less they use their limbs the more flesh will they put on, but we always permit ours their liberty for the first month of their life, as they make bigger framed birds in this way. For the last six weeks their liberty is curtailed, and this is the period in which they make weight. If quick growth is to be made, the young ducklings must not be exposed to heavy rain, nor to hot sun till they have got their first feathers. Ducklings suffer from heat very severely, and losses from sunstroke are not uncommon in the case of birds hatched in the warm months.

The first feeds should consist of hard-boiled egg and bread-crumbs mixed with a little cooked rice and moistened with milk. Ducks have huge appetites, and six times a day for the first fortnight is not too often to feed them, the feeds being gradually reduced until they are having only three meals a day for the last six weeks.

After the first few days their food may alternate between rice, barley-meal or maize-meal, mixed with toppings, chopped green food, cooked meat, soaked bread, and sharps. Rice is extremely cheap and very suitable, and should always be thoroughly cooked, allowing it to simmer very slowly until all the water in which it is placed is absorbed. It is a mistake to imagine that ducks prefer their food in a very moist condition—it should be moist, certainly, but never "sloppy." The water trough should be kept well filled, but it is not advisable to allow them to drink too much, and it is really better to remove it between meals. Coarse sand in the water aids digestion, and fine grit should always be available. The food should be varied as much as possible, and we have found a well prepared cooked food, when mixed with bran and middlings, an excellent and inexpensive food, which pushes the young birds on well. Chopped vegetables should be added to the menu, and onions are particularly good for ducklings, and much relished by them. For the last fortnight of their lives the addition of animal fat and intestines should be made to the menu, and many authorities highly recommend locust bean meal as fattening agent. Greaves and any kind of offal fat will be necessary for the final fattening. Oatmeal is too expensive a food to use much, but one feed a day of oatmeal mixed with skim-milk will bring ducklings on amazingly, and any backward ones will make astonishing progress if allowed this dainty.

The best breed for table purposes is undoubtedly the Aylesbury, and the professional "duckers" of the Aylesbury district can get weights of 5 lb. on their birds even at eight weeks old. As a rule ducklings are killed from nine to twelve weeks, it not being profitable to keep them after the first pin feathers begin to grow. The great thing to do is, of course, to push them on as rapidly as possible, keeping an eye on the markets, as a week or ten days may make a difference of one shilling or eighteen pence per duck—all the difference between a nice profit and none at all! American duck rearers use the Pekin breed a good deal, but it is not much fancied here except as a cross with the Aylesbury, for which purpose it is admirable.

Over here the pure Pekin does not appear to reach the size that it does in America, probably because here the Aylesbury has been specialised in for so many years that by the course of selection the breed has become the finest for its purpose. The Pekin requires more liberty, and American rearers allow their ducks more room than English, so that its greater size in that country is partly due to the recognition of its natural inclinations.

The buff and blue Orpington ducks are coming more and more to the front each year, both as table ducklings and as layers. They are extremely hardy, and are quick growers, though in maturity do not approach the Aylesbury for size. The Orpington ducks approach perfection as table birds, for the flesh is very tender and of good flavour, and the general build of the body is conducive to a good distribution of flesh.

It would be unwise for the beginner in duck fattening to attempt too much at first, but the majority of poultry keepers would find it very profitable to rear a couple of dozen ducklings for local disposal, the experience thus gained being put to wider account next session.

It is a mistake to attempt to run ducklings and chickens together. The chickens cannot thrive as well, the ducklings make their drinking water very dirty and trample on their food, even if served (as it should be) in wooden troughs, and though this does not appear to be in the least degree prejudicial to the health of the ducklings themselves, it is extremely bad for the chickens, and results are never so satisfactory as if the two are kept quite separately.—E. C. Davies in Feathered Life.

BROODINESS IN WHITE LEGHORNS.

Mr. D. F. Laurie, reporting on the Egg-laying Competitions, 1913-14, held at the Government Poultry Station, Parafield, South Australia, remarks as follows :—"On various occasions, and in previous reports, I have called attention to the question of broodiness in White Leghorns. At Parafield, this year, following a long established custom, a careful record has been kept of all cases of broodiness which have occurred among the White Leghorns in the competition pens. There is, of course, a record of all cases of broodiness, whether in White Leghorns or in other breeds ; but the subject now under discussion relates only to White Leghorns. This year the percentage of broodies is practically the same as last year.

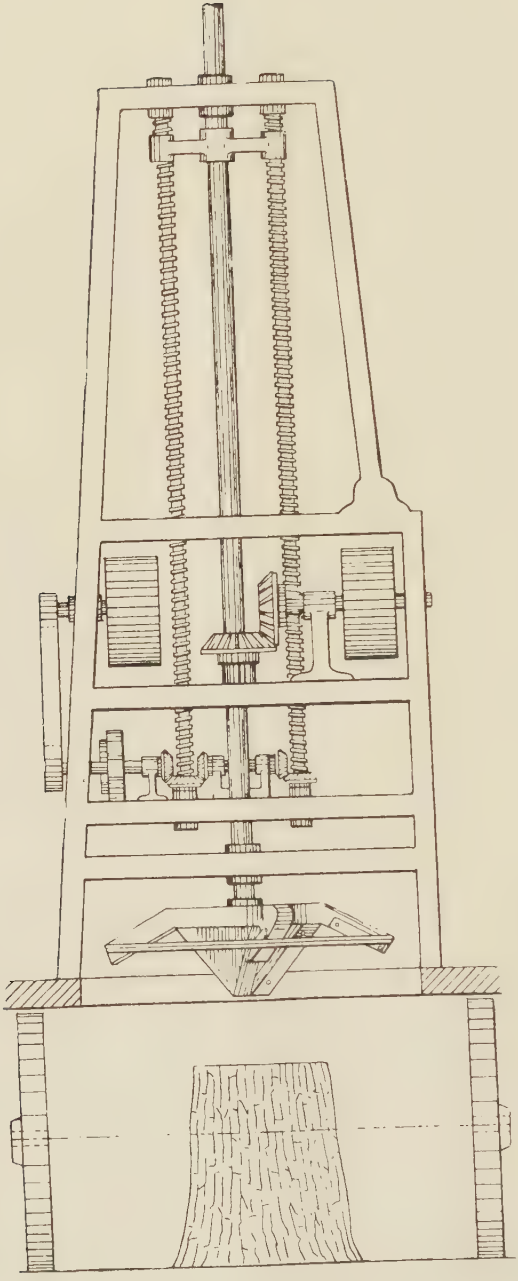
In Section 1, Open Class, and 3, Producers' Class, there were 125 pens = 750 White Leghorns. It will be interesting to note the occurrence of a reversion to the ancestral maternal instinct in these pens. Each case of broodiness is noted, and the offending bird is removed to the broody pens. In the case of White Leghorns, an additional legband is placed upon the bird, and should she subsequently—during the currency of the test—again become broody, a mark is cut upon the aluminium legband. This is done for the guidance of the owner, who is advised not to breed from this bird.

I would again impress upon breeders that the reappearance of broodiness among White Leghorns is a taint, even as are cases of coloured feathers. Both can be eliminated, but only by strict and accurate methods of breeding. I am aware that it is the practice in many private poultry plants to do no more than segregate for a time all broody hens. When the broody instinct wanes the birds are returned to their pens. This, of course, is permissible in flocks which are kept for market egg production if no such birds are sold as breeding hens. To breed from a hen which at any time has shown the slightest indication of broodiness is in my opinion the height of folly. That hen will transmit through her cockerels the inclination to broodiness, and, as is bound to be the case, those cockerels will be mated with a percentage of hens in which the "broody" instinct is present. To breed from such birds taints the strain to a degree not generally understood. We see from the figures quoted that in 44 pens there were no cases of broodiness reported, yet pens in which broodiness occurred number 81, nearly twice as many—the ratio is practically 2-1. In the work of single testing as carried out during many years at the poultry stations the least sign of broodiness on the part of a White Leghorn pullet meant the sounding of her death knell. It is a practice of mine to pass under review at frequent intervals all the White Leghorn hens and pullets on the poultry station, and to have promptly dealt with any cases of broodiness however slight. I have not accumulated sufficient evidence yet to enable me to tabulate data that will support my long-held conviction, viz., that the inheritance of some characters is influenced by a time period or cycle. That is to say, I believe that the time will come when we shall recognise that hereditary characters are subject to "masking." I do not believe that the progeny of parents homozygous for any character will intermit, i.e., that some cases will show "presence" and others complete "absence." I believe that the character will be present in all the progeny, but that there may be a period of "masking."

I am strongly opposed to the erroneous notions held by some people that broodiness is a period of rest designed by nature to serve as a period in which to recuperate after a long period of egg-production. Such a belief is quite contrary to the reason for and nature of "broodiness," i.e., the maternal instinct to "brood" to guard and forward the interest of the embryo within the egg. Our domestic hens lay their eggs anywhere convenient, and when they have laid they appear to have done with that egg. This is because the "natural instinct to brood" has in some breeds been eliminated by a course of selective breeding. The "broody period" is solely nature's provision for maternal duty. The "rest" theory is pure moonshine.

THE ORIGIN.

It is rather a difficult matter to arrive satisfactorily at any conclusion as to whether broodiness in White Leghorns is due to a reappearance of a lost character among absolutely pure White Leghorns, or whether it is due to some comparatively recent admixture of foreign blood. I have definite knowledge that in some strains there has been a deliberate infusion of White Wyandotte blood, and in others there have been accidental matings with the white heterozygotes of White Leghorn male and Black Orpington female crosses.



A STUMP CUTTING MACHINE.

GENERAL.

A STUMP-CUTTING MACHINE.

A machine for cutting down stumps 6 inches and more in diameter has been devised and patented by A. L. & G. D. Moore of New Orleans. The machine is shown in the accompanying sketch ; it is strongly built and can be attached to any tractor. In working it is propelled to the stump and the cutter head is made to revolve at 400 revolutions per minute. The cutter head is lowered by a friction feed operated by a rocking lever. The thickness of the chips or shavings is regulated by the feed screws.

The cutter can be regulated so as to penetrate 18 inches below the surface of the ground, if necessary, so as to consume all the stump, leaving only the minor roots.

The cutter head is so formed that, with the velocity of working, the chips are thrown upwards by a centrifugal motion. The chips are guided by a hood or jacket and are blown in one direction so that they can be sacked or carted away. The principal object of the machine is to clear cut-over lands from stumps, leaving the land ready for cultivation. At the same time the stumps are cut into small chips which can be used for the manufacture of bye-products such as wood pulp.

It is worked by two men and the cost of the oil fuel is estimated at $3 per day of 10 hours.—Monthly Bulletin.

"RUTHERFORD"

The issue of a sixth edition of Rutherford's Planters' Notebook, coming as it does within a few months of the fifth, is evidence, if such were needed, of the phenomenal and thoroughly deserved success of the work. The merits of the earlier editions have long been known to the Ceylon planter, but the later volumes, which include a mass of information relating to Malaya, should make it equally indispensable in other countries also. Indeed, no planter in the tropics can afford to be without it, since it epitomises the accumulated experience of Ceylon planters, whether in tea, rubber, cacao, etc., in tabloid form.

As might be expected, much of the additional information in the new edition relates to rubber and coconuts, all of it completely up to date, while, for the first time, detailed instructions and estimates for cacao planting are included. A new section on fibres, etc., will be of assistance to those who wish to try their luck with secondary products. In all cases, the information is vouched for by leading practical authorities in their respective subjects, and no one need have the slightest hesitation in following the advice given.

We hope—though admitting that the hope is vain—that the present edition is large enough to satisfy all demands. In that case we may succeed in keeping a copy on our shelves longer than we were able to keep previous issues !

THE CASTOR-OIL PLANT.

EUPHORBIACEAE: RICINUS COMMUNIS, ARAND.

(Paper read at the Meeting of the Board of Agriculture on 11th August, 1914.)

The Castor-oil plant is a native of the tropics, forming a perennial bush or small tree, and grows from sea level up to 6,000 feet. At low elevations its growth is perennial, but at high elevations it is an annual. Excessive moisture is unfavourable, but a good rainfall after sowing is essential for germination. The seed germinates rapidly after burning off cheddy, followed by rain.

It flourishes on well drained alluvial loams, but free sands and clays are unsuitable. It is an exhausting crop requiring a good deal of nitrogen and phosphoric acid to mature the seed.

Propagation is by seed only, and it can be grown alone or as a mixed crop. In large areas the plant is liable to caterpillar attacks, and it is therefore more suitable for growth by villagers in comparatively small and isolated areas.

There are said to be sixteen varieties, but they are usually grouped under two forms. A large seeded variety giving a large yield of an inferior oil, and smaller seeded varieties, some of which give good medicinal oil. One variety with glaucous coloured leaves and smooth fruit is said to yield a harmless edible oil. The small tree of perennial growth is usually planted as a light shade for more valuable crops. It gives a large seed with much inferior oil suitable for burning and for machinery as a lubricant. The other is an annual and is grown alone or with other crops in mixed cultivation. It gives a small seed, which yields the best kind of Castor oil for medicinal and other purposes, but requires a more careful method of expression. The Coast seed of Coconada is said to be the best for oil.

The plant is largely cultivated over some 200,000 acres in Bengal, Madras and other parts of India including the Deccan, and it grows freely in Ceylon both in the dry and wet zones. 67,000 acres are under Castor in the Madras Presidency alone, chiefly in Coimbatore.

In Bengal the seed of the small and large sized plants are sown in May to July with some other crop, the crop being ripe in January and February. Another medium variety yielding more oil is sown in September and the crop harvested in March and April.

Red soils at the foot of hills are usually chosen as irrigation is necessary ; the weeds are kept down by ploughing between the rows of plants.

Picking is usually from the 7th to 9th month after sowing, and when grown with other crops it is said to yield about 250 lb. per acre ; and when grown alone from 800 to 900 lb., thus yielding a revenue of Rs. 15 to Rs. 30 or more per acre. In Bengal and Oudh it is planted with other crops in rows 6 to 10 ft. apart and plants 3 ft. apart in the rows, and begins to yield ripe fruits in 7 to 8 months ; the picking lasting four months.

Mixed castor and groundnut are commonly grown in India.

In the United States, in 1875, 24,145 acres were under castor in Kansas alone, the average yield being 15 bushels per acre ; and in Iowa the yield is about 15 to 25 bushels of seed per acre worth from $ 2½ to $ 3 (Rs. 7·80 to Rs. 9·40) per bushel.

The fruits are collected, heaped and covered with straw or cloth. After 6 days the capsules soften and the shells decay, when they are exposed to the sun for two days for the shells to dry and open. The larger varieties are buried in a manure heap and then dried in the sun as before.

A vigorous plant yields as much as 16 to 20 lb. in a season, ample air and light being necessary. For the large varieties wide planting is therefore advisable, say 10 to 15 ft. each way, giving 435 and 302 plants per acre. Thirty lb. of fruits give about 24 lb. of kernel.

Usually the plants are cut down to 2 ft. after cropping, when they give another crop for one or two years, though of a rather inferior seed.

The average yield per acre is said to be 650 to 1,000 lb. in the first year, and 1,000 to 1,500 lb. in the second year when grown alone, or half that quantity when grown as a mixed crop. The seed realises about Rs. 4·80 per 100 lb.

Castor seed is rich in oil containing from 48 to 50 per cent. and is usually expressed twice, the first time cold, the second time hot.

The best medicinal oil is the cold drawn, and as it fetches a higher price it pays to express as much as possible by this first process, for which the seed must be clean and free from impurities. In Europe under modern conditions immense presses are employed using a pressure of 3 tons on the square inch. The seed is fed whole to kettles and warmed with steam to 32° C (89°F) and then pressed, the resulting cake containing 8·5 to 10 per cent. of oil.

If less powerful presses are employed, the cakes are ground in roller mills, and either heated and again pressed, or treated with solvents such as Carbon bisulphide, Carbon tetrachloride or petroleum ether, which extract all but 1 per cent. of the oil. For manuring purposes the cake from the latter process is more valuable, as the proportion of nitrogen is higher and any contained weed seeds would be destroyed.

In Calcutta the oil mills use up 700,000 cwt. of seed brought by rail from Bengal and the United Provinces. It is chiefly the large seeded variety, the small seeded variety being obtained from Madras by coasting steamers.

In India the oil is expressed in 3 or 4 ways.

(1) The seeds are crushed in a screw press with horizontal rollers and the resulting pulp pressed in gunnies, yielding 36 per cent. of cold drawn oil.

(2) The seeds are roasted, pounded, and placed in four times their volume of water kept boiling. The mixture is stirred constantly and the oil skimmed off as it rises to the surface.

(3) The seed is first boiled, dried for two or three days, then pounded and treated as above.

(4) The seed is soaked overnight in water, ground in a gunny and squeezed within cloth until the oil has been obtained. The oil is purified by bleaching in the sun, which causes a sediment to precipitate; it is then filtered through vegetable charcoal and flannel bags. Ten per cent. more oil is said to be obtained by heating the press.

It has been found unnecessary to husk the seed before crushing, as the husk neither absorbs nor colours the oil. By using the whole seed 42 per cent. of oil may be obtained by modern methods of pressing with a hydraulic press alone, crushing rollers, kettles, moulding machines and clothes being unnecessary. This would, however, mean a cake with less nitrogen, and therefore of lower manurial value.

The oil is pale yellow, very viscous and is largely used for lighting purposes, as a preservation for leather, and as a lubricant for machinery. It is also used as a mordant for Alizarin dyed fabrics, the special preparation being known as Turkey Red Oil.

Ordinary native oil sells at Rs. 12 to Rs. 19 per 100 lb. and the medicinal cold drawn oil from Rs. 30 to Rs. 33 per 100 lb. The Import rate is about Rs. 18 per cwt. with an import duty of Rs. 1·20 per cwt. for the crude oil, while the pure cold drawn oil is valued at Rs. 91 per cwt.

The cake is regarded as a good fuel and is used in the manufacture of gas, which in some respects is superior to coal gas. It is, however, chiefly used as manure for potatoes and sugar cane, and is largely imported into Ceylon for manuring Tea, Rubber and Coconuts.

In 1900	8,084	tons were	imported	valued at	Rs. 58·00 per ton
1905	10,494	,,	do	,,	64·50 ,,
1909/10	13,872	,,	do	,,	77·50 ,,
1911/12	12,215	,,	do	,,	74·20 ,,
1912/13	4,190	,,	do	,,	88·80 ,,

The largest amount was in 1908 when 15,950 tons were imported and valued at Rs. 58·10 per ton (equivalent to about 30,000 tons of seed.) The imports have gradually fallen off since owing to the poorer quality, the percentage of nitrogen being now only 5 per cent. against 6 per cent. in former years. The deficiency has been largely made up by an increase in the imports of groundnut cake, the quantity in 1912/13 being 15,627 tons valued at Rs. 87·10 per ton. Rape cake is also largely imported, the imports in 1911/12 being 6,038 tons valued at Rs 66 per ton. In 1912/13 however, this fell to 1,486 tons valued at Rs. 40·50 per ton.

Groundnut cake keeps practically constant with 7 per cent. nitrogen, and Rape cake with 4 per cent., but there is a distinct difference in cost per lb. of nitrogen in each cake.

Castor cake	...	5 %	nitrogen	costing	85 cts. per. lb
Groundnut cake	...	7 %	,,	,,	70 ,, ,,
Rape cake	...	4 %	,,	,,	92 ,, ,,

It should be quite possible to produce a pure castor cake in Ceylon, containing 5½ to 6 per cent. nitrogen, and there is a ready market for every ton produced. If pure and slightly cheaper per unit, it would largely replace some of the other nitrogenous manures imported, including part of the fish manure, of which 18,338 tons were imported in 1911/12 valued at Rs. 58·60 per ton.

The oil should also find a ready sale, for export and local consumption, about 6,000 cwt, being imported annually.

The castor oil plant grows freely in many parts of Ceylon from sea level to 5,000 feet, and the drier districts of the North-Central Province, Eastern, Southern and Uva Provinces are especially suitable for its cultivation.

It is suggested that the cultivators in these Provinces be encouraged to grow the castor oil plant in their chenas, in a similar manner to the mixed cultivation in India; and that the Railway Stations, Dispensaries and Post Offices be made centres where the cultivators could take any quantity from a measure upwards of their pure seed and receive cash in payment. A measure of average small seed weighs 1 lb. 2½ oz. and contains about 3,000 seed. The rate would be fixed monthly according to the price of castor oil and cake, and printed slips in Sinhalese and Tamil would be posted for the cultivators' information. The price of castor seed c. i. f. Colombo varies from Rs. 160 to Rs. 190 per ton or 7 to 8½ cts. per lb. Allowing for freight, transport and crushing, probably from 5 to 6½ cts. per lb. or Rs. 5·60 to Rs. 7·28 per cwt. could be paid to the villager. When sufficient seed is collected, this would be forwarded to the nearest station and thence to Colombo, where it would be crushed for oil and cake.

Messrs. Freudenberg & Co. have kindly experimented with 7½ tons of seed imported from India, to ascertain the yield of oil and cake and the cost, with a view to fixing an approximate rate that could be paid in different centres. Their experiment confirms the above rate.

The experience with tobacco in the Teldeniya district shows that the cultivators appreciate being able to receive cash direct for their produce without deductions, etc., as the area under tobacco is rapidly increasing

round the manufacturing centre. The experience with castor should be the same, as the growth of the plant can be done with little extra labour, and the picking of the crop after the harvesting of the Maize or Kurakkan could be done by the women and children of the families.

If sown in chena crops it would prevent the land lapsing into jungle for at least two years, and although an exhaustive crop, the land would have fully recovered within the 6 or 8 years during which it reverts to jungle.

The annual variety can also be grown in rice fields with a leguminous plant immediately the rice is harvested, and should be sown about 2'-3' apart. Under these conditions it is said to yield 525 lb of seed, giving 200 lb. of oil and 266 lb. of cake. Experiments have been conducted at Mahailuppalama, Peradeniya and Hambantota with fairly satisfactory results, especially in the latter district.

The following table shows the physical and chemical composition of different varieties of castor seed:—

CASTOR SEEDS.

1. Indipore, light back ground, streaky red brown, partly mottled.
2. Red Erundi of Dhulia, darker black ground, mottled, reddish brown but more or less in lines.
3. Surat, small light back ground, darker markings streaky and mottled
4. Parel, markings more distinct than three.
5. Similar to three.

	1.	2.	3.	4.	5.
Length	1·25 c.m.	1·4 c.m.	1·0 c.m.	1·2 c.m.	1·1 c.m.
Weight of 10 seeds	3·55 Gms.	3·45 Gms.	2·30 Gms.	3·378 Gms.	2·81 Gms.
Skin	0·98 ,,	0·90 ,,	0·60 ,,	0·86 ,,	0·77 ,,
Kernel	2·57	2·55 ,,	1·70 ,,	2·51 ,,	2·03

ANALYSIS.

Moisture	5·21 %	5·07 %	4·67 %	4·43 %	5·55 %
Oil	48·56 ,,	49·77 ,,	48·92 ,,	50·62 ,,	48·47 ,,
Proteids	17·10 ,,	18·20 ,,	19·33 ,,	17·10 ,,	18·20 ,,
Carbo-hydrates	8·67 ,,	8·46 ,,	8·73 ,,	7·33 ,,	7·82 ,,
Woody-fibre	17·22 ,,	15·39 ,,	15·13 ,,	17·26 ,,	17·20 ,,
Ash	3·24 ,,	3·11 ,,	3·20 ,,	3·26 ,,	3·06 ,,
	100·00	100·00	100·00	100·00	100·00
Lime	0·52 %	0·34 %	0·44 %	0·48 %	0·44 %
Magnesia	0·61 ,,	0·62 ,,	0·68 ,,	0·53 ,,	0·54 ,,
Phosphoric Acid	1·43 ,,	1·56 ,,	1·51 ,,	1·43 ,,	1·56 ,,
Potash	0·59 ,,	0·52 ,,	0·51 ,,	0·51 ,,	0·50 ,,
Nitrogen	2·74 ,,	2·91 ,,	3·10 ,,	2·74 ,,	2·02 ,,

The nitrogen in the kernel is 3·5 % and 0·7 % in the husk, which explains why the darker coloured cakes are always poorer in nitrogen. The large proportion of phosphoric acid in the ash should be noted. Most Ceylon soils are deficient in this constituent, so that the application of phosphoric acid to this crop should prove beneficial.

M. KELWAY BAMBER.

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A REVIEW OF THE SOCIETY'S WORK IN CONNECTION WITH LAC CULTIVATION.

(*Read before the Meeting of the Board of Agriculture on 11th August, 1914.*)

In the paper on "Lac Culture as an Industry for Ceylon" submitted by me at a meeting of the Board of Agriculture in January, 1912, soon after my return from Pusa, and published in the Tropical Agriculturist, Vol. XXXVIII., No. 2 (February 1912), with a note from Mr. E. E. Green, the then Entomologist to the Government of Ceylon, I observed that in India two crops are taken in a year, one called "Kartiki" at the beginning of October (from inoculation done in June-July) and the other called "Baisaki" in June-July (from inoculation done in October corresponding to our "yala" and "maha" seasons, but that in Ceylon we should have to determine our seasons after making trials in several localities. Since then we have made several trials, the first series of which were carried out in October, 1912, in the Kandy and Hambantota districts at two places in each district, viz., Peradeniya and Maligatenne Estate in the former case and Tangalle and Ambalantota in the latter. These centres were selected with double object of ascertaining the influence on lac production and of introducing the industry into places in the vicinity of which lacquer-work was carried on.

As the result of these first trials inoculated brood lac became established in Masan (Zizyphus) trees, but the extraordinary rains that followed and the interference of red ants did great damage to the growing larvæ at Tangalle, Ambalantota, and Peradeniya.

Specimens of the lac produced on Maligatenne Estate was forwarded to the Imperial Entomologist at Pusa who supplied original brood lac and his report was encouraging.

No brood lac, however, could have been obtained from this crop and a fresh supply of Indian Kusum or Kon (*Schleichera trijuga*) lac was obtained from Pusa in February, 1913. The inoculation with this was very successful especially at Maligatenne Estate where Kon and Masan trees were used. The dates of inoculation and cropping of the lac at Maligatenne are as follows :—

Inoculated	...	25th February, 1913
Cropped	...	2nd August, 1913
Inoculated	...	2nd & 3rd Do.
Cropped	...	15th January, 1914
Inoculated	...	15th Do.
Cropped	...	6th June, 1914

The brood lac from this last crop was used for inoculations in Kandy, Kurunegala and Matale districts, and has taken well in all cases.

From the above it will be seen that some knowledge has been gained in the study of local seasons which are not the same as in India where three distinct seasons exist. The "Kartiki" crop takes about four months while the "Baiaski" takes over eight months. Our seasons seem to be more uniform owing probably to more or less variation of air temperature and more regular rainfall, and as a result the lac takes nearly the same time to come to maturity each season, viz., about six months. Subsequent trials will, I think, go to confirm this opinion.

In view of the fact reported by Mr. Green that his attempts during a period of 11 years, beginning from 1900, to establish the Indian lac insect in Ceylon resulted in failure, the Ceylon Agricultural Society might congratulate itself on the success that has attended its efforts.

I would here invite attention to Mr. Green's remarks on page 123 of the Tropical Agriculturist for February, 1912.

It is to be hoped that the Society's efforts will ultimately result in supplying the local demand for lacquer work and give a fillip to that industry.

Samples of lac were sent to the Hony. Secretary of the Kandyan Art Association and these were used in lacquering walking sticks which were on view at the recent Agricultural Show at Nuwara Eliya. The workmen complain of an excess of gum, but it is probable that this could be remedied by better washing. They are prepared to pay Rs. 1·25 per pound which is a good deal in advance of the London market quotation in 1911 (vide Professor Dunstan's letter to the Secretary, Ceylon Agricultural Society, in which 55 shillings per cwt. was quoted). The local demand of lac is at present very limited but with the encouragement now being given to indigenous arts and crafts it is not unlikely that the demand will increase.

The initiative of the Society in this matter is most fortunate inasmuch as the clearing of forests is making it very difficult for lac workers to procure wild lac on which they have been so long depending. After a time it is hoped that the lac workers themselves will raise their own with the assistance of the Society. In fact a beginning has already been made this season and a few men have already started operations.

Fresh samples of lac have also gone to the Imperial Institute, to the Imperial Entomologist, India, for report, and also to the Museum of the Department of Agriculture, and the Colombo Museum for exhibition.

Chief trouble so far experienced in lac cultivation is the destructive nature of the red and other varieties of ants. These ants by coming in contact with the growing insects break the breathing filaments and cause their death by

suffocation. This opinion is based on my own observation as authorities in Ceylon and India have asserted that ants do not cause any more trouble than "milk" the lac insects.

In giving over my duties to my successors (Messrs. W. Molegode and Jas. R. Nugawela) who have acquainted themselves with the work, I must express my thanks to the Secretary of the Society for having recommended my being sent to the Pusa Institute with a view to gaining a practical insight into lac cultivation as the e carried on, and to all those who have assisted me in my work, notably Mr. K. B. Beddewela who placed his land so conveniently situated near Kandy at my disposal and devoted much of his time to carrying out experiments which mainly through his careful attention to details have been attended with success.

N. WICKREMARATNE.

CATTLE BREEDING IN THE MADRAS PRESIDENCY.

GRAZING CONDITIONS.

The question of grazing is becoming more and more insistent as the area of cultivation increases, and therefore the question deserves detailed examination.

Communal grazing. This consists of grazing on land to which every one in the village has an actual or accepted right. This is comprised of communal lands set apart for the purpose, of unassigned waste lands, of tank beds, the sides of drains, roads and other poramboke land; usually also of harvested wet lands and of dry lands which have been left fallow. Many of these sources of grazing, as the cultivated area extends, or the village expands, are constantly being reduced in area and thus the ryot, who has depended on free grazing from time immemorial, is on all sides beginning to feel, and sometimes acutely, the lack of pasture. As time goes on and cultivation continues to expand either intensively or extensively, he will feel it more and more, until some other method of farming is evolved, which includes the care of his animals. In some parts of the Presidency this evolution can be seen even now, of which the Dharapuram taluk of the Coimbatore district is an excellent example. This is a taluk where there is no culturable waste, no communal grazing land, and no forest grazing; yet, it is one of the best known cattle breeding centres of the Presidency, and its cattle have a higher market value than any other, besides which, it contains some of the best garden cultivation to be seen anywhere in India, as well as an excellent system of mixed farming.

As far as the maintenance of the quality of the stock is concerned nothing can be said in favour of communal grazing; in fact everything is against it. Where there is communal grazing, every ryot in the village naturally claims as large a share of it as possible, with the result that grazing lands are always overstocked, are never given a rest, and are usually little more than exercise grounds for cattle. In many cases the number of cattle maintained is in excess of the ryot's actual requirements, as well as of the number which he can normally supply with fodder in the dry season, and though the animals may manage to exist for a time on a starvation diet, they are very prone to cattle disease and to suffer from changes of season. Enquiry into the hide trade shows that the supply of hides is always greatest when the rainy season commences. Not only do animals die under this treatment, or lack of it, but the female stock breed very irregularly and, if the cows are not barren altogether, they seldom calve more often than once

in three to four years. This is a most important point ; the quinquennial census shows that, on an average, a cow only rears a calf once in $5\frac{1}{4}$ years. Communal grazing is, and must be mixed grazing, and, since male stock are never castrated before they reach maturity, this leads to the evils of inbreeding and promiscuous breeding and often permanent injury to the young male stock from serving cows when too young. Thus, even if the ryot were desirous of improving his stock by more careful breeding, this is impossible as long as he has to depend on communal grazing.

Forest grazing. This is ordinarily the grazing of cattle in the reserved forests on payment of a nominal fee per head, though, in times of scarcity, the forests are thrown open, when necessary, for free grazing. Normal forest grazing can be divided into three classes :—

(a) Cattle, which live entirely or almost entirely in the forests and are kept in pens there, i.e., breeders' cattle, such as those of East Kollegal and the west of Dharmapuri and Hōsur.

(b) Cattle, belonging to villages adjoining the forest which are occasionally breeders' cattle, but more often are kept, either for the sake of the manure which they supply, or for the sake of prestige ; a man's position and wealth in the village being reckoned by the number of stock which he keeps.

(c) Cattle, which come from a distance to graze in the forests during the cultivation season.

Forest grazing is always a serious menace to the forests and not only to the forests but to the water supply of wells and tanks. It is more so where grazing is continuous as the cattle are then in the forests when these are dry. Grazing and forestry are, and must be, at variance ; for, as the forest canopy increases, the grass tends to disappear, and the simplest way of lessening the shade and increasing the grass is by forest fires. Yet certain kinds of forest grazing are of great importance.

Private grazing areas. Private grazing areas are of great value and importance to the country and every encouragement should be given to increase these. Everywhere where private grazing grounds exist, the cattle are good and care is taken to breed and rear good animals. This class of grazing can be divided as follows :—Temporary pasture and permanent pasture. Temporary pasture consists of harvested dry fields, of patta lands left waste (though in many cases these are treated as common grazing lands) and of patta lands, which are sown down to pasture. Permanent pasture includes patta land reserved for pasture, either on single or on joint patta, and, either for a leased rental, or for the pattadars' own enjoyment.

Dry lands when newly harvested are usually considered as private grazing. There is often a considerable amount of gleanings in the shape of fallen pulse and cereal leaves and, until this fodder supply is exhausted, such lands are usually reserved for the grazing of the cultivator's own cattle. Patta lands, which are left waste, are occasionally treated as private pasture, but, more often than not, are treated as common grazing land.

The only two places where patta lands are regularly set apart for grazing, i.e., for temporary pasture, are in the two noted cattle breeding centres of "Plain Cattle," viz., the Ongole-Kandukur tract and the Dhārāpuram-Palladam tract. In the former tract, permanent pasture is perhaps more common, since the soil is very liable to wash, and there are large areas of patta land which cannot be cultivated, such as the lands adjoining rivers and streams. These streams can always be traced by these grass lands and by the growth of babool which gives the requisite shade for pasturage. But besides this, temporary pastures are also common ; even small areas of 3—4 acres or less are left for pasture, showing that even the smaller ryot of

these fertile soils realizes the value of pasture for his cattle. Such temporary pastures are all of spontaneous growth and are not sown. In the Kangayam tract, temporary pasture is the rule, though exceptionally good pastures are often left for 20—30 years before being broken up. It is here that the famous "Coimbatore grass" known as "Kolai kuttai pillu" (*Pennisetum cenchroides*) is found and the seed of this grass is regularly sown, mixed with a cereal, when land is to be laid down. Here private pasturage is rendered much easier by the practice which prevails of fencing the fields. So valuable are pastures considered here, especially since the recent rapid increase in the price of cattle, that even garden lands are now occasionally laid down to pasture. This moreover is the only place in the Presidency where anything like systematic grazing is carried on.

Permanent pasture. The practice of maintaining permanent private grazing grounds, although in some parts it is giving place to dry cultivation, in others is showing signs of development, and this should receive every encouragement, as it is the first step towards the improvement of live stock. The practice is common throughout Nellore district and in the Kistna and Gõdãveri dry taluks, as well as in the North of Salem and in the Punganur zamindari of Chittoor district, while a few cases have come to notice where the system is of quite recent origin, even in parts where forest grazing is considered good. It is held by some that the cultivation of grass on patta lands lessens the yield of food grains but it is a moot point whether this is so. Land laid down to temporary pasture is greatly enriched and, when ploughed up again, gives much better yields of grain. Moreover private pasturage enables the ryot to maintain not only his working animals, but also his small breeding herd and, if he owns his well in addition to his dry land, he is enabled to manure his garden lands well and to meet his own supply of working bullocks. Thus, though the dry lands may not directly produce cereals when under pasture, they tend to increase the production of the garden lands, and after all, except perhaps on black cotton soils, the production from the land is very largely governed, not by the area cultivated but by the amount of manure available.—REPORT ON CATTLE SURVEY OF THE MADRAS PRESIDENCY.

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THE EFFECT OF INJURY TO TAPROOTS.

Dr. G. Tobler-Wolff has carried out experiments at Amani, German East Africa, with the object of determining the effect, on the growth of the plant, of injuries to the taproot of coffee and tobacco in the operation of transplanting. The results of these experiments appear in Der Tropenpflanzer for June, 1914.

Forty seedlings of Quillou coffee about 6 cm. high, with well-developed taproots were selected. The taproots were 14 to 16 cm. long. These were divided into four groups of ten each, which were treated in the following way :—

In the first ten, the root tip was enclosed in a block of Plaster of Paris, about 1 cm. long and ½ cm. thick. In the second ten, one to two centimetres of the root was cut off. In the third ten, the taproot was cut off up to about 2 cm. below the collar. The fourth ten were left untreated as a control. All the plants were then planted out. The experiment was begun on the 5th of December, and the plants were dug up for examination at the end of February in the following year. None of the plants died, and all were normally developed.

In Group I, all growth in length of the taproot was prevented : a fairly abundant development of lateral roots had taken place, especially near the collar. In Group II, the root tip was in no case regenerated, and the taproot had consequently not grown longer : lateral roots had developed as in Group I. In Group III, lateral roots had been abundantly produced, but the seedlings of this group differed from the others in that the taproot was replaced, sometimes by an almost vertical lateral root, sometimes by a bundle of vertical lateral roots, side by side, and equally strongly developed. The control plants showed a well-developed taproot.

The experiment was repeated with Tobacco seedlings, 4 to 6 cm. high with a taproot 4 to 5 cm. long. As the growth in this case was more rapid, more definite results were obtained. When the plants were examined, at the end of two and a half months, they were 70 cm. high.

The results with tobacco corresponded exactly with those with coffee. In most cases of Group II, the taproot had not lengthened, but had thickened remarkably. In Group III, the beginning of a replacement of the taproot was observed in seven out of the ten cases, sometimes by a single lateral, sometimes by from 2 to 4. In Group IV, four examples showed a well-developed taproot, but in the other six the taproot had been injured in transplanting and had developed strong lateral roots.

Dr. Tobler concludes that the effect of an injury to the taproot during transplanting has, in general, been overestimated. In all cases, whether the injury was great or small, the growth of the plant above ground differed very little, or not at all, from that of the controls. A certain degree of injury is necessary for the replacement of the taproot by a single lateral, but the character of the replacement makes no difference to the growth of the plant.

SELECTION OF INDIAN CORN FOR SEED.

No planter should depend on buying seed every year, but, if it is necessary to do so, it is best to secure it in ear, when, if unsatisfactory, it may be returned to the shipper. The seed should be prepared for planting by first removing the bud and tip kernels and any others of irregular shape, then shelling the remaining ones by hand. The Office of Corn Investigations,

United States Department of Agriculture, has tried many shellers but found none as satisfactory as the hand for shelling seed corn. Uniform kernels are an advantage, but cannot be successfully obtained unless the separation is made while they are all attached to the ear.

Six kernels from every ear to be planted should be tested for germination. The value of this work is easily shown by the following paragraph taken from Bulletin No. 135 of the Iowa Experiment Station: "The untested corn in 1910 gave a stand of 50·5 per cent. and a yield of 55·5 bushels per acre; the ears which tested 6—0—0 in 1910 gave a stand of 21·8 per cent. in stand and 19·6 bushels in yield. In 1911 the untested seed gave a stand of 52 per cent. and yielded 35·6 bushels per acre, while the ears testing 6--0—0 gave a stand of 73·95 per cent. and a yield of 45·7 bushels, a gain of 21·6 per cent. in stand and 10·1 bushels in yield. The average stand for the two years of untested seed was 51·25 per cent.; of the tested 73·1 per cent.; the average yield of the untested seed was 45·5 bushels per acre, of the tested, 60·4. Therefore, testing gave an average increase of 21·85 per cent. in stand and 14·9 bushels in yield per acre."

The production of seed corn for home use is worthy of consideration by every planter in the State; it will be the principal means of increasing the yield per acre. There are three methods of selecting seed corn; (1) crib selection, (2) field selection, (3) selection of the progeny of high-yielding ears by means of an ear-to-row breeding plot.

Field selection should be done as soon as the corn is thoroughly mature. When ears are taken from a crib for planting the kind of stalk on which they developed is never known. The ear is simply a collection of fertilized ovaries joined to a spike and encased in a bundle of shucks. They not only possess ear characteristics but those of the stalk as well, and if the stalk is not noticed when seed is picked out the best results cannot be expected. Physical characters of ears and stalks must be kept in mind. Strong, healthy and medium-sized stalks, producing the number of ears desired with the ears of sufficient height to be above pea-vines in a normal year, but within reach of the harvester, will answer every purpose. When a man is sent to the field to harvest corn one-half of his energy should not be used in breaking the plant in order to get hold of the ear. Such a condition is a waste of time and money. The ears should bend over instead of standing erect so as to prevent water collecting between the ear and shuck, thereby causing the corn to rot. Depending ears is an hereditary character and by rigorous selection a strain of corn having this characteristic well developed may be obtained. The practice of breaking corn is dying out, excepting in those areas where it grows very high. The ears hanging down prevents injury from birds. Even with these characters well developed, the ears should not be selected unless they are well covered by the shuck; this is one of the best and cheapest methods of fighting the weevil. The corn that is gathered for seed from the field must be re-selected in the barn or crib, where all objectionable ears are thrown out. Knowing which ears to retain is sometimes a difficult matter. Williams, Ohio Bulletin No. 212, gives the following ear characteristics as conducive to high yield:—

1. Length above the average but not extreme.
2. Cylindrical shape.
3. Well-filled tips.
4. Smooth ears.
5. Heavy ears, not extreme.

If the above points are sought, the yield will certainly not be decreased.

After doing careful field selection followed by rigorous ear study, the individual ear character for yield is not known. Two perfect ears may look exactly alike, but may have many different yielding powers. The only method by which this is determined is by means of an ear-to-row breeding plot,

that is, planting each individual ear to a row. A uniform area of land containing as many rows as ears to be planted (not less than 100) should be selected away from any other field of corn. If it be possible, get three-eighths to one-half mile away from other corn fields, unless the plot be located on the south or west side, when it need not be over one-fourth of a mile away. The predominating winds during the summer in this section are from the south, south-west and west, hence the danger of cross fertilization may be less. A field of corn planted from a pure strain is a homogeneous mass of hybrids, and the breeding plot may be located within it, where the same kind of corn is to be planted. This is probably the better way to locate the plot as then the chances for cross fertilization with other varieties are lessened. Pure strains of different varieties of corn should never be crossed as the first generation may be a lower yielder than either parent, but no one knows this until it has been tried. Hybrids from pure strains of the same variety usually produce greater yields for the first few years.

One-half of each row in the breeding plot should be detasseled so as to prevent inbreeding. Do not remove the tassels from all the rows at one end of the plot, but take them from the even numbered rows on one end to the middle and then go to the other end and do likewise with the odd-numbered ones. In this way the female and male characters may be studied. Notes should be taken on the different rows as to height of stalks, height of ears on stalks, number of ears on stalks, number of depending ears, and the amount of shuck over the ears. At time of harvesting, two sacks should be used for each row, one for the detasseled portion and the other for the part not detasseled. Each sack must be weighed in order to determine the yield of each row. The corn from the part of the row where the tassels were not removed may be thrown away as it is more or less inbred.

In order to call your attention to the usefulness of a breeding plot, the following results are given :—

Louisiana State University, Yellow Creole Corn, 1913 :
Lowest yielding row, 22 bushels.
Highest yielding row, 48 bushels.

The physical character of the stalk may be changed without damaging the yield. The Illinois Experiment Station increased the average height of ears in six years from 56·4 inches to 57·3 inches, and decreased the height from 42·8 inches to 23·1. In five years the average crop for declination from the perpendicular was forty-six degrees, while the declining ear strain was 88·5 degrees. The erect ears gave a greater percentage of mouldy or rotted corn by 3·28, which shows the practicability of having the ears hang down. —Louisiana Planter.

COFFEE LEAF DISEASE.

(HEMILEIA VASTATRIX B. AND BR.)

The most serious of coffee diseases is undoubtedly that caused by *Hemileia vastatrix*, and generally known as Coffee Leaf Disease. In this article it will be referred to as *Hemileia* disease.

It has been responsible for large monetary losses, and for the abandonment of coffee-growing in various parts of the world. The example of Ceylon is well-known. The fungus is now distributed over all the coffee-growing countries of the Old World. The only seeming bar to its progress is the breadth of the Atlantic Ocean, for it has not yet been recorded from the coffee areas of South America.

Hemileia is endemic in this part of Africa. It occurs on practically every tree of "native" coffee (*Coffea robusta*, Lind.), and has done so for many years. Only recently, however, was any attention paid to its presence and still more recently was it shown to be the same species as is found on "cultivated" coffee, viz., *Hemileia vastatrix*. Probably the fungus has been present on "cultivated" forms of coffee in Uganda for several years. Its presence may have been known, but there was no definite diagnosis of the fungus, and its significance was unrecognised. The planting up of large areas of coffee during the last few years has provided the fungus, already in the country, with a vast amount of fresh host material, and the parasite has not been slow to take advantage of its opportunities. During 1913, the loss of crop due to *Hemileia* disease was, in many cases, as much as 30 per cent.

It is important to remember that *Hemileia* is endemic in Uganda, and that, therefore, it cannot be expected to cause as much damage as it did in Ceylon, to which country it was introduced.

[This is a new reading of the evidence. Mycologists are generally agreed that *Hemileia vastatrix* is endemic throughout the tropical regions of the Eastern Hemisphere.—ED.]

The virulence of the attack of 1913 may be repeated in part during the coming wet season of 1914, especially on new estates, but it is unlikely that its severity will continue unabated year after year. The fact that "native" coffee is more seriously affected by *Hemileia* disease during some years than during others lends support to this view. No hitherto unaffected estate, or new estate, can hope to escape infection, and the experience of the older plantations will probably be repeated. It is a hopeful sign that trees, which lost practically all their leaves and crop owing to *Hemileia* disease in 1913, are now covered with fresh foliage, have produced many new shoots, and are in a fair way to bear good crops. Should this experience become more general than it is at present, and should the hope that *Hemileia* outbreaks will be less virulent than formerly be realised, the outlook for coffee planting will be bright indeed. Planters can do much towards this consummation by adopting the measures mentioned below.

There seems to be an impression abroad that spraying, as a measure against *Hemileia* disease, is "of no use" and is, in addition, "not worth the cost." This is far from being the case, so long as the spraying is done systematically. The cost of spraying varies with local circumstances, but, on the whole, an average cost per acre of, say, Rs. 3, is quite within reason. This figure is representative of the planting districts of Buganda.

Measures designed to check or prevent leaf-disease should be based upon the following recommendations:

1. Danger of infection may be reduced by:

   i. Provision of wind-belts and light shade. Heavy shade conduces to dampness and so aids the development of *Hemileia*. *Dolichandrone platycalyx*, Baker, (Lusambya) should not be used as a wind-belt. It harbours insects which attack coffee, and an algal parasite (*Cephaleuros mycoidea*, Karsten) which attacks rough-leaved plants generally. Coffee should be planted in small plots, cut off from each other by wind-belts, and so arranged that prevailing winds sweep them crosswise rather than lengthwise.

   ii. Destruction of all fallen leaves. Burying is the best method.

   iii. Plucking and destruction of diseased leaves, especially in cases of small outbreaks.

   iv. Wide planting. 8' × 8' is recommended.

v. Spraying with Bordeaux or Burgundy mixture at regular intervals, and particularly *before the onset of wet weather*. Spraying is a preventive as well as a checking measure. It is a mistake to imagine that young trees should not be sprayed. Leaf disease has occurred in Uganda nurseries.

2. Germination of infection-spores may be hindered by :

i. Choice of a dry rather than a moist locality for nurseries and plots. Nursery shade should be light and at least 5 feet above the ground.

ii. Spraying according to para. 1. v. above, and during the wet weather, when germination and the consequent infection are most likely to take place.

3. The resisting power of the coffee tree may be increased by :

i. Attention to general estate sanitation and cultivation.

ii. Growing plants from the best seed only.

iii. Rejecting all weakly plants when planting out.

iv. Manuring, on the principle that affected trees require a stimulus to enable them to replace lost foliage or to carry through a dry season.

As already indicated, the source of *Hemileia* disease on "cultivated" coffee may well have been the disease on "native" coffee trees. Therefore it is advisable to take precautions. Native "shambas" should be examined for coffee trees, and the trees for disease. When leaf disease is present on coffee in a native "shamba" from which labour is drawn or with which there is traffic of any kind, the estate owner or manager should give attention to the danger of the introduction of leaf-disease from the infected "native" coffee.

No estate in Uganda can hope to escape infection, but it is possible to reduce the effects of leaf-disease to a minimum by keeping a sharp look-out for the appearance of the disease and by carrying out the measures mentioned above.—Circ. No. 1., Department of Agriculture, Uganda Protectorate.

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HEDYCHIUM CORONARIUM FROM CALCUTTA.

In Kew Bulletin, 1912, p. 373, a detailed account appeared of investigations made by Messrs. Clayton Beadle & Stevens into the possibilities of *Hedychium coronarium* as a source of material for paper-making. The experiments were made with dried material from Brazil and with fresh stems grown in the Royal Botanic Gardens, Kew. Subsequently a supply of the dried plant received from the Royal Botanic Garden, Sibpur, Calcutta, was forwarded to Messrs. Clayton Beadle & Stevens, who have examined the same to see if the plant would give similar results from different parts of the world.

The following report has been furnished by Messrs. Clayton Beadle & Stevens:—"The botanical specimen sent over from Calcutta are complete, dried-down specimens, whereas the *Hedychium coronarium* examined from Brazil was in the form of crushed fibre produced by passing the green, freshly cut stems through sugar rollers to express the juices, prior to drying for shipment. This in itself constitutes an important difference. We had our doubts whether complete specimens in the dried-down condition could be rendered serviceable in the manufacture of paper because the complete specimens from Brazil had undergone fermentation. In the condition as sent from Brazil, however, we believe that they were packed in a green state, whereas those sent from Calcutta were presumably carefully dried before packing. We have recently cut down a green *Hedychium* stem and passed it through crushing rollers, and we find that of the dry weight in the complete green stem there is 23 per cent. of organic matter contained in the juices and 77 per cent. of dry crushed material. These juices are of an acid nature and have a powerful reducing action upon Fehling solution, and it is to the presence of these juices in the green stems as sent from Brazil that we attribute its destruction in transit. The dried down specimens from Calcutta do not appear to have suffered from any putrefactive changes, due—we presume—to the fact that they were completely dried before packing.

"The Calcutta specimens were boiled with 10 per cent. (of 77 per cent.) caustic soda for four hours at 2½ atmospheres, washed free of liquor and lightly brushed for three hours in a hollander, then made into paper without any added sizing material.

The soda consumed on the raw material ...	=	6·0 %
,, ,, on paper	=	18·0 %
The yield of unbleached paper on raw material	=	32·5 %

This on a basis of 77 per cent. crushed fibre would yield 43 per cent. of paper on the weight of the crushed fibre. Brazilian crushed fibre yields under similar circumstances 50 per cent. unbleached paper. The sheets of paper produced from the Calcutta fibre were examined in different thicknesses, and substances, and yielded the following figures for bursting strain :—

Thickness in mm.	Substance grams. per sq. m.	lb. Demy.	Bursting strain in lb. per sq. in
·10	80	21	26
·13	110	30	53
·14	115	31	55
·28	230	62	105

These figures are satisfactory. The material boils down readily, it is easily beaten to the condition of pulp, requiring comparatively little power; it drains well and felts well when made into paper, and has a good wet strength after couching, and there should be no difficulty in manipulating it upon the paper machine.

"The 'Waterleaf' is not ink-proof as that produced from the Brazilian fibre is, but this is probably due to the fact that whole specimens sent home dried down contain juices which probably had some effect upon those natural constituents (pith cells) which give to the *Hedychium* fibre these peculiar self-sizing qualities.

"We think this statement is probably true, because *Hedychium* green stems from Kew, Paris, and elsewhere, have shown self-sizing qualities if crushed to remove the juices and immediately used, or if the crushed material had been dried down for shipment after the removal of the juices. The above paper is of a good kraft colour with a strong tear and a rattle and should be very serviceable for ordinary wrapping papers. It is elastic, has a good breaking strain and bursting strain and possesses good folding and wearing qualities. We are disposed to conclude that *Hedychium coronarium* will yield good paper-making qualities from whatever part of the world it is gathered, and that any differences in the qualities of the above-mentioned material from Calcutta as compared with that from Brazil (which latter we have thoroughly investigated) are to be attributed to differences in the preparation of the raw fibre prior to shipment rather than to any difference in the growth of the plant itself."—Kew Bulletin.

HEDYCHIUM FLAVESCENS FROM CEYLON.

The following report has been furnished by Messrs. Clayton Beadle & Stevens to the Director of the Botanic Gardens, Kew, on a consignment of dried stems of *H. flavescens* despatched from Ceylon.

"We duly received a bundle of dried stems of *Hedychium flavescens* which you forwarded to us from Ceylon when you informed us that the Director of Agriculture was anxious to have it tested as to its suitability for paper-making. We regret that the work has been so long delayed.

The material arrived in very good condition and, if it could be supplied in bulk in the condition in which it arrived, it would be a very convenient form for converting into paper. [The stems were passed through the rollers of a rubber washing machine before drying—Ed.]

We tested it by ordinary paper-making processes and found that it could be converted into paper, samples of which we enclose herewith, which in a large measure resembles the paper obtained from *Hedychium coronarium*.

By a process of direct conversion, whereby *Hedychium coronarium* will yield paper equal to 90 per cent. of the dry weight of the stem, *H. flavescens* yielded 60 per cent. The probability is that, by ordinary paper-making processes, by boiling under pressure and subsequently beating and so forth, whereby *Hedychium coronarium* has yielded in bulk 60 per cent. of paper, the *H. flavescens* would yield probably about 40 per cent., but this is a point that might be tested later on. The paper from *H. flavescens* is ink-proof and has a good rattle and strength and is what we call "normal hide-bound" paper.

The mean bursting strain, corrected to a thickness of 0·1 milligrams (=a substance 84 grams per sq. metre), was 49 lb. to the sq. in,, and the mean breaking length 6·35 kilometres. This may be described as a strong paper, very much resembling that obtained from *H. coronarium* under similar circumstances."

H. CORONARIUM IN THE MALAY STATES.

Mr. I. Henry Burkill in his Report on the Botanic Gardens, Singapore and Penang, for the year 1913, remarks that one-twentieth of an acre was given up to an experiment with *Hedychium coronarium:* but it showed no such vigour as would make it worth growing for paper stuff.

In The Paper-Maker and British Paper Trade Journal, Messrs. Clayton Beadle and Stevens furnish the following alphabetical list of papers for which Hedychium can be used without admixture of other fibres:—

Backing papers, bag papers of all descriptions, box boards, browns of all descriptions, butter papers, "caps," carpet felt papers, cartridge papers, casings, coloured papers, copyings, cutlery papers, duplex papers, engine boards, envelope papers (many kinds), fly papers, foil papers, glazed boards, greaseproof papers, grocery papers, hosiery papers, kraft papers, leather boards, manillas, mill boards, mill wrappers, paper yarn, parchment (imitation) pin and needle papers, portmanteau boards, printings (many kinds), railway tickets, sampling papers, "shops," "skips," tea papers, tissues, tobacco papers, toilet papers, tube papers, wrappings.

THE WATTLE INDUSTRY.

In our last issue (January 1914) we published the regulations which have been framed to permit of the grading of wattle bark exported from the Union. It will have been observed that the regulations do not render such grading compulsory, but we feel sure that the majority of the wattle growers of Natal are sufficiently alive to the interests of their industry to welcome such provision as will tend to secure uniformity in the shipment of bark. Whilst we believe in the future of the wattle industry, such future will only be assured by a careful study of the requirements and the changes which take place in the economies of the tanning industry. One of these requirements is the grading of wattle bark exported, a measure that has become almost as necessary as the grading of maize. It is simply a following of the principle which all modern producers realize—that uniformity brings better prices.

Let us glance at the position of the wattle industry at the present moment. Briefly put, it amounts to this: the production of bark is on the increase, whilst the market for bark is at least stationary and possibly becoming restricted. Wattle bark was formerly employed somewhat extensively in England, and the tanning material it provides is an excellent one mixed with other substances. Tanners, however, have got so much into the habit of using prepared extracts that they will now hardly be troubled with the extraction of solid materials, with which it is difficult to obtain liquors of the concentration which is now required. In fact, Hamburg is now practically the sole market for raw bark. What the future of the wattle industry will be if we continue to export bark, and bark only, it would be difficult to prophesy, but the indications at the present time certainly point to a gradual lowering of price as the production increases. And who knows when the German tanners may drop raw bark in favour of prepared extract as the English tanners have done?

That is the position as we find it to-day; and the matter now resolves itself into this: Cannot the preparation of extract be undertaken in this country for export, without at the same time a complete cessation of the shipment of raw bark? The export of extract would relieve the Hamburg market of big supplies of raw bark. This would tend to raise the price of raw bark, and at the same time secure to us markets in England, America, and elsewhere for our produce in the shape of extract. The question is well worthy of careful consideration.

THE WORLD'S SUPPLY OF TANNIN EXTRACTS.

The scarcity of tanning materials in the world's markets is receiving serious consideration, and experiments are being conducted in India and the tropics generally with a view to the establishment of large plantations of tannin-bearing trees. The production of hemlock bark in the United States has

fallen from 900,000 tons per annum to 600,000 tons in 1909. The quebracho extract industry in the Argentine is also gradually becoming more difficult to maintain. Quebracho would be the principal competitor of wattle bark, but the supply is a diminishing one, as the trees are not, we believe, being replanted, and prices are constantly rising. In order to give some idea of the immensity of the extract industry, it may be stated that the United States consumes £4,400,000 worth of tannin materials every year. Of this quantity about £3,000,000 worth consists of hemlock bark and about £1,000,000 quebracho extract. England imports about 100,000 tons of quebracho extract every year. The world's consumption of vegetable tanning materials is difficult to arrive at, but it has been estimated to represent not less than 15 millions sterling per annum.

The relation of South Africa's output of wattle bark to the world's consumption of tanning materials may be roughly calculated. Last year we produced approximately 60,000 tons of dry bark. This represents about one-tenth of the output of hemlock in the United States, and only about 2½ per cent. of the world's consumption. When it is considered that the supplies of hemlock and quebracho are gradually lessening, it will be seen what an opportunity there is for South Africa to step in with her new product—wattle extract. Apart from Natal, there are some thousands of acres planted with wattles in the low veld of the Transvaal, whilst small plantations also exist in the Cape Province. And there are doubtless extensive areas not yet planted which would be suited to the growth of the *Acacia mollissima*.

AN EXTRACT INDUSTRY FOR SOUTH AUSTRALIA.

What are the possibilities of the establishment of a wattle extract industry in South Africa? The question has long been the subject of investigation by the Natal Wattle Growers' Union, and the information in their hands seems to prove that the shipment of liquid extract from South Africa to the European market is not feasible, owing to expense in procuring suitable casks and the heavy freight on such goods. As regards solid extract, it has been thought that this could not be satisfactorily made on a commercial scale owing to the precipitation of a portion of the tannins on redissolving the solid extract.

This naturally is a most important point; and in order to obtain authoritative opinion, the Department of Agriculture wrote last year to one of the heads of certain well-known leather industries' laboratories in England. This gentleman replied: "I feel certain that such an extract can be prepared and ought to be a profitable manufacture, and much of the small twig and branch bark might be utilized, which at present is not worth the cost of stripping. . . . . There are, no doubt, practical difficulties in manufacturing on a commercial scale a good solid extract of wattle bark, but I can speak confidently as to these being surmountable, because I have recently had two such extracts submitted for my examination, both of commercial quality, and one of them of great excellence and free from insoluble matter." (With regard to the last point it may be observed that ordinary quebracho extract contains very considerable quantities of insoluble matter, and it has been necessary to elaborate processes by which this matter can be kept in solution.)

This pronouncement was made some months ago, and since then it has been ascertained that certain gentlemen in this country, who have expert knowledge of the processes involved, as well as the necessary plant, are contemplating the erection of a factory which will deal with green bark and prepare a solid extract for export. Preliminary negotiations are now proceeding, and the public will doubtless have a definite announcement placed before it at no distant date. Wattle growers will, we are sure, join with us in wishing this enterprise every success, for upon its success or that of some similar undertaking will depend in a very great measure the future of the wattle industry in South Africa.—South African Agricultural Journal.

LEGUMES.

Such plants as bear their seeds in pods, as all those we call peas and beans, many wild plants, the Guango tree, the Cashaw, etc., belong to the family called Legumes.

A great deal has been written in this Journal for the last 14 years about these Leguminous Crops, as "cover crops" and "green dressings," to be grown through staple crops like bananas or sugar canes, or coconuts, or orange trees or cotton, and among catch crops like corn or yams and so on. It is an old and common practice to plant beans through corn and on the yam hills. Growers did not know why they did this, but it was observed by generations of cultivators that peas and beans grown through other crops agreed with them—so much is this the case that the common Red Kidney Bean (market name "Red Pea") is called "Yam Bank" pea in that noted yam growing parish Hanover, the home of the famous Lucea Yam, an esculent appreciated more than any other in the rest of Jamaica and wherever Jamaica people go, so that quantities are shipped to Panama and Costa Rica on the demand of Jamaica people there.

When yam hills are made, Kidney Beans are planted on them and give a crop in 8 weeks without interfering with the yam at all.

But the great good that Leguminous crops can do to the soil is not gained when the crops of seed (peas and beans) are reaped, because these seeds or grains are strong and nutritious foods and naturally must take a great deal out of the soil, although less than other crops.

The peculiar characteristics and advantage of Leguminous plants are that they are not dependent upon the soil for their supplies of nitrogen but are able to draw what they need from the air. All plants, as most people know nowadays, require nitrogen, potash and phosphoric acid chiefly, besides lime (and also iron, sulphur and other elements that are rarely mentioned, the soil usually having enough) in order to be able to make their roots, stem, leaves, blossom and seed, and these elements they get from the soil they grow in. All crops grown on or sold from the land mean a steady loss of fertility. All the bunches of bananas, all the coconuts, the cocoa, the coffee, and oranges sent abroad have come out of the soil. Some crops are more exacting than others, corn for instance, but as corn is used here, if only all the droppings of horses, mules, and fowls fed on corn were carefully saved and returned to the soil there would not be much loss, and then it would be some little consolation that though we do spend so much in importing corn from America we would be getting something back in the shape of manure. But there is so great a lack of the economy common in some other countries, that unfortunately we do not even have this discount on the money sent abroad for corn.

Plainly and naturally, lands that have grown crops long cannot remain always so productive without help, and this is especially so with quick crops like bananas (as compared with slow growing tree crops), which give 400 bunches averaging say 40 lb. each every 12 to 15 months, that is 16,000 lb. weight per acre less the water contained in the bananas; practically 4,000 lb. of solids are sent away from every acre of bananas here every year. The soil becomes thinner, more gritty, with less of the soft fibrous matter in it which is called humus, and which is rich in nitrogen. Now nitrogen is the element which causes quick succulent growth of stem and leaf, and it is the most expensive element to buy. In an artificial fertiliser it is priced at about 9*d*. per lb. while phosphoric acid is about $3\frac{1}{2}d$. and potash $2\frac{1}{2}d$. or thereabout. Stable manure or cattle dung are most valuable for the humus they contain, which holds nitrogen as well as potash and phosphoric acid. In

Jamaica such animal manure is scarce and to bring it from a distance or from towns where it is *wasted*, to country fields where it is *fertility*, is expensive because of its bulk and the high railway freight. It is a pity that some combined organization could not be secured whereby all town manure could be collected and transported to fields. A special train run at night could not offend the eyes or nostrils of sensitive people.

Fortunately if nitrogen, when it has to be purchased, is the dearest of manures, it is yet the easiest for the cultivator in the tropics, where growth goes on the whole year through, to get and add to his soil, through the agency of legumes.

The seed of some of the legumes which are used for green dressings, we can eat, like Cowpeas, Blackeye Peas, Caroline Peas, and all the Kidney Beans ; and while that is an advantage in time of scarcity, as after the drought and storm of 1912, it means that plenty of people delude themselves into the idea that they are doing something for the soil in simply growing Cowpeas, when they are not. In selling the seeds—the peas and beans—they are sending away the concentrated essence of the plant. The grower does add some humus and has had a cover crop to keep down weeds, but it is essential for manuring the soil that the plants be cut down when they are in bloom, for just at that time the plant is concentrating all effort in fulfilling the purpose of its existence and that is to make seed. We take it then, interrupting this process by cutting it down, and we have thick covering of vegetable material rich in nitrogen, lying on the soil, while underground the strong roots also rich in nitrogen have opened up the soil and will rot quickly. It used to be the practice to turn in the mass of green stuff into the soil at once. In this Journal for December 1900 we wrote of an experience we had in doing this ; we turned masses of Velvet Beans into a clay soil in the hot weather and in a moist climate, and the strong smell of acidity, sourness, which came from the soil thereafter taught us a lesson. Further it is the best practice to aim at growing cover crops during the good growing weather of the autumn and let them lie in a mulch from the middle of December through January and the very dry month of February, and early March,—according to the district. This can also be done for the dry weather of July, or such a crop grown as will last through the whole year. That is all according to a grower's wants, circumstances, soils and district.

Now too much should not be expected from these legumes, used for cover crops and green dressings. They can add humus and nitrogen to the soil and sometimes more, because of their being usually deep rooted, in which case their roots, especially on clay soil, get stores of potash and phosphoric acid there, which probably were out of reach or locked up from the roots of the chief crop. But it cannot be expected that such leguminous crops will do more than add nitrogen to the soil. Something must be done otherwise. We can add lime directly and sometimes it is contained also in a fertiliser like Basic Slag, which is used for the phosphates it contains but has a large proportion of lime in it.

Now some crops behave very curiously in the tropics, especially when we come to apply fertilisers, which on paper, and on some crops, do what is claimed for them. But here according to the experiments carried out by the Department of Agriculture in bananas, and by the Department of Agriculture, Trinida, on cocoa, sometimes fertilisers are negative in results, or show no increase in crop for the money spent. But with crops like peas and beans there is absolutely no doubt of the increase of production, through an application of a fertiliser containing only potash and phosphoric acid. Any one can easily prove this by fertilizing one or two rows and comparing results both as regards vine and crop if need be. The quick acting fertilisers enable

the roots of the peas and beans to grow more vigorously and go deeper, the vines are stronger and more powerful, there is then a larger crop of vegetable material to be cut down to lie upon the soil, later be added to it and which becomes humus rich in fertility, for the roots of bananas or other chief crop to feed upon.—Jamaica Agric. Soc. Journ.

PROGRESS REPORT OF THE EXPERIMENT STATION, MAHAILUPPALAMA.

(From April 20th to June 20th, 1914.)

COCONUTS.

The fourth picking of 1914 was done on April 28th. The number of nuts collected was 927 from 206 trees: an average of 4·5 nuts per tree. This gives an average total of 16·5 nuts for the pickings of 1914 up to date.

Of the picking, in the cultivated area, 181 trees gave 817 nuts, an average of 4·5 nuts per tree. In the uncultivated area, 25 trees gave 110 nuts, an average of 4·5 nuts per tree.

The fifth picking was done on June 5th. The number of nuts collected was 1,847 from 273 trees: an average of 6·75 nuts per tree.

This gives an average total of 23·25 nuts for the pickings of 1914 up to date.

Of the picking, in the cultivated area, 242 trees gave 1,685 nuts, an average of 7 nuts per tree. In the cultivated area, 31 trees gave 162 nuts, an average of 5·25 nuts per tree.

With regard to copra production, the following figures have been obtained :—

	Picking.	Break.	Rejections.	Copra lbs.	No. of nuts Required per Candy.
Combined Plots ...	March	558	2	239	1,281
Plot A Cultivated ...	March	506	2	217	1,280
Plot B Uncultivated ...	March	52	0	22	1,323

The two beetle traps which were constructed, one on January 21st and the other on February 15th, were opened on April 21st for the convenience of the German Entomologist who had come over to inspect them. About 150 larvæ of various stages of development were collected from each trap.

Most of the larvæ found in the three month old trap, appeared to be approaching the pupal stage.

These beetle traps serve, amongst other things, the double purpose of (1) disposing of coconut rubbish which might otherwise remain lying about, thus affording breeding grounds for the black beetles, (2) facilitating the destruction of large numbers of the larvæ.

Fresh traps have been constructed to serve other parts of the plantation.

G. HARBORD.

THE ABRASIN OF TONKIN.

An account of the Abrasin, a species of *Aleurites*, appears in the Bulletin de l' Indo-Chine for March-April 1914. The writer, M. Lemarie, Directeur des Services Agricoles et Commerciaux du Tonkin, discusses various species of *Aleurites*, which are exploited as a source of oil.

M. Lemarie reviews recent work on these oil yielding species, and points out that from the Japanese species *Aleurites cordata*, it has been found necessary to detach the Chinese species *A. Fordii* Hemsl. and the Chino-Tonkinese species *A. montana* Wils. He doubts the reported presence of *A. Fordii*, the most interesting species, in the whole of Tonkin, and found personally, besides the *A. triloba* Forst. (variously known as the Molucca nut, Bancoubir or Candle tree) which is generally accepted, only the type "Cay tran" corresponding to *A. montana* Wils.

The wood of this tree is white, and of small durability; although the Annamites and Chinese sometimes use it for building for want of a better, it yields a mediocre timber fit only for firewood.

The species which yield a drying oil, employed pure or in mixture, for varnishing and waterproofing of articles, are found on the mainland. The Japanese species, which is the true *A. cordata* R. Br., gives an oil used only as an illuminant, which is rapidly falling out of use owing to the spread of kerosene. The Chinese product on the other hand burns badly, giving off much soot: this property is taken advantage of in the manufacture of the best known Chinese inks.

For ages past, however, the oil has been used for coating wood and cloth: Loureiro reports that he has seen it mixed with lac (produced from *Rhus succedanea* Lin.) to increase the fluidity or simply, he confesses, to increase its volume.

This oil has been known in Europe since the old Portuguese trading days. To-day it is exported to Europe and America in enormous quantities, for the manufacture of paint, varnish, drying agents, linoleum, rubber substitutes, etc: in fact there is no end to its uses, and one could hardly say how great would be the demand for it, should its production increase.

According to the Chinese Customs Returns (E. H. Wilson in Bulletin of the Imperial Institute Vol. XI No. 3) the export from Hankow rose from 44,030,400 lb. worth £1,132,052 in 1900, to 80,927,733 lb. worth £2,116,816 in 1910. From Wuchow on the West River the export was in 1910, 3,262,533 lb. worth £47,729 (the greater part if not the whole of this was produced from *A. montana*) and in 1910, 6,947,466 lb. (value not mentioned). From Hongmoon, a little port on the Canton delta, there was exported a small quantity, also the product of *A. montana*. The consumption in China itself is considerable.

Formely the Europeans knew only the product from the South of the Chinese Empire, the first settlements being in Kwang-tong, later transferred to Macao. The Chinese call this product mu-yu, on account of the necessity to crush the nuts from which they extract it, and the commercial name "Wood oil" is a literal translation of the Canton name.

When latterly commerce spread to the more Northerly regions, the same name was retained by the Europeans for a product similarly employed, although the Chinese designated it by another name (Tung-yu) and extracted it from a nut whose covering was not lignified, i.e. that of *A. Fordii*.

Further, no one made any distinction between the two from the commercial or industrial point of views, since the necessary botanical details just given were lacking to show the possibility that these oils could have different characteristics and properties. Their chemical analysis requires reinvestigation: indeed, whatever the geographical origin of the samples examined, we do not know exactly from what species they come, nor even if they are mixed.

The tree "mu-yu" (*A. montana* Wils.) is confined to the subtropical parts of S. W. China from Fokien to Annam, while the tree "Tung-yu") (*A. Fordii*, Hemsl.) which appears to furnish nine-tenths of the total production, belongs rather to the warm temperate zone of the basin of the Yang-tse.

E. H. Wilson shows that only the terminal flower of each cyme is female, the others usually male. It appears certain that the species from Central China produce many more flowers than that cultivated in Tonkin. It bears fewer flowers on each inflorescence, but produces a greater abundance of inflorescences, and appears more branched and upright.

The Tonkinese form produces, like the above one, a female flower isolated at the apex of a cyme, and sometimes even only at the centre of the panicle: the inflorescence is often composed only of male flowers. It would appear that the plant has a tendency, not, as the above author supposes, to group its flowers in unisexual inflorescences on the same tree, but rather that the plant tends to become dioecious. M. Lemarie mentions that he has seen, at least, that certain trees in the same flowering season bear many more male flowers than their nighbours, and asks if this is a permanent individual characteristic or a temporary accident due to external causes, or dependent on the age of the tree.

On the other hand, as *A. Fordii* is known to produce more abundantly and its fruits are more easily worked, since they do not need to be pounded down, its cultivation might be attempted on the high plateaux of Tonkin. The plant apparently accommodates itself to all soils, even the rockiest and poorest, if the rainfall reaches at least 28 inches per annum. It does well on slopes, and can endure a high temperature. Its growth is rapid, and the tree flowers in its second year, but it is short lived.

The increasing demand for oil and fruits of the Abrasin not only in China, but in Tonkin also, should induce planters to extend their plantations. M. Lemarie is of opinion, however, that in most cases it would be advantageous to export only the oil.

Sales of Produce in British and Continental Markets.

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PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

(From 15th April to 15th June, 1914.)

TEA.

The yield for the months of April and May was 11,728 lb. green leaf – the price 6½ cents.

The dadaps on plots 144 and 149 have been pruned. The green material which weighed 1,876 and 2,490 lb. respectively was mulched in alternate lines.

On plot 147, the *Tephrosia candida* has been supplied.

1,121 vacancies in the Manipuri Indigenous plots 146—150 have been supplied with one year old stumps purchased from Kotiyagala Estate, Bogawantalawa.

On plot 150 the old Albizzias have been lopped weighing 3,073 lb. and new plants planted to take their place next year.

CACAO.

Two rounds of picking have been completed, the spring crop being of average quantity.

The autumn crop is setting well.

The lower branches of the dadaps have all been lopped off. Next year it will be advisable to leave these lower branches and lop the tops as the trees are becoming too tall.

Plots 63—67 of young cacao have been manured according to the experiments instituted by Dr. Lock, except that instead of trenching between the rows or broad-casting and disc-harrowing, the manure has been applied to each tree in half-circle, at a distance of four feet. This has been necessary owing to the fact that the branches of the trees now prevent harrowing. Further, on the middle trench being dug, no cacao roots were found to have reached so far, but dadap roots were so plentiful that the manure would only benefit them and not the cacao.

The unshaded plot has been supplied with young plants from No.2 tree and a heavy shade of *Tephrosia candida* planted.

Cacao drying has been carried on with considerable difficulty, as the shed is under repair.

COCONUTS.

All the coconuts under manurial experiments have been clean-weeded in a 6 foot ring and the plots cleared of all bush.

Dr. Friederichs visited the two traps laid down and found about 100 larvæ of the rhinoceros beetle in each. He advised that rough stone or brick walls would be better than the logs, because the larvæ attack the latter and this would necessitate destroying these logs each time. He also stated that the traps should be dug up, the larvæ destroyed and the decaying matter burnt, every three months at most, and the traps then relaid with fresh material. Six traps with stone walls have now been set in the young coconut plots.

Holes were dynamited, left exposed for three weeks and on June 15th were supplied up with 100 young palms three feet high from nuts laid down last April. 100 more plants are wanted. Nuts have been obtained from Goluapokuna Estate, Negombo, and set out in a nursery.

One young seven-year old palm in plot No. 53 is bearing 15 bunches with a total of 140 nuts, or an average of 9 per bunch.

Holes were also dynamited in the old coconut plots and 80 one-year old palms planted, the plants being obtained from our own selected nuts.

RUBBER.

All the new plantations have been supplied with stumps from our own and Heneratgoda nurseries.

The *Tephrosia candida* in all plots was cut at the beginning of June and mulched, and all vacancies have been resown.

Plots 14 and 15 have been sown broad-cast with *Indigofera arrecta* and harrowed, and plots 73—76 with *Crotalaria incana*.

VANILLA.

Those flowers that were fertilized have set very well and the pods look very healthy.

FRUIT AND SHOW PLOTS.

These have all been sown with various green-manure, vegetable and fruit seeds. The untidy piece of old fort earth-works near the office has been cleared, shaped, turfed, and planted with ornamental shrubs to serve as a monument to the Portuguese who were massacred there.

GRAINS.

Four varieties of Sudan Dura have been received from Khartoum. The fine seed arrived in splendid condition and has been sown both by hand 1 foot apart (about 8 lb. per acre) and broad-cast (same amount) and harrowed in. It is germinating exceedingly well. Seed has been sent for distribution to Mr. Drieberg and to Mr. Harbord.

Several varieties of maize and Kaffir-corn have also been sown, as well as beans, grams and ground-nuts.

The 4 months' paddy was sown on May 20th.

BANANAS.

Now that the rains have set in, the bunches of fruit have begun to swell and will soon be ready for cutting. A few ripe bunches of *Suwandel* have been cut and when thoroughly ripe have been cut into slices with a thin bamboo and sun-dried to make banana-figs for which there is quite a demand, besides being a method of utilizing an over-supply of ripe fruit.

A disease has made its appearance and has spread considerably. The same disease exists in the coolies' gardens from which many of the suckers were taken. The disease is under investigation.

DRAINS.

About 10 acres of newly cleared land has had to be drained. In those plots (18, 19 and 20) intended for part of the collection of economic products, it was found the land formed a cup with no natural exit for the water. A drain 10 feet deep and 50 feet long has therefore been cut, in order to allow the water to escape. As all this land has long been water-logged and soured, 500 lb. per acre of lime has been broad-casted over it and the land thoroughly ploughed and harrowed. With this treatment, the land should soon be brought back into condition.

LABOUR.

Now that the planting season has begun, the pinch of our small force has been very severely felt and the work much handicapped. As we do not belong to the Ceylon Labour Commission, the difficulties in the way of our obtaining more labour are considerable. The Head Kangany, however, is leaving for India and will endeavour to bring back some forty coolies with him.

D. S. CORLETT.

THE CEYLON PEASANTRY.

BY R. CHELVADURAI-PROCTOR.

To understand the ways of the bulk of the population of Ceylon, study may well be begun in the paddy field. It would appear on close examination that the characteristics of the people—their religious feelings, civic sense, social outlook, and standards of personal honour—are expressed or reflected through the various processes of their industry. Truly the industry has been the means of slowly modelling the character of the man, who, while responding to its influences, has, in his turn, left his own imprint upon it. Various as are the conditions of climate, soil, etc., the habits of the people show a correlation with them, while racial differences have set their own seal upon the various processes of the industry. Thus it happens that in this small Island of ours we do not meet with uniformity either in method, or in ceremonies, or in customs, of the people who follow the same industry in life.

What a difference one notices in the formation of beds of the paddy fields in two districts : the North and the Central Province. In the former district, they are rectangular, formed with straight ridges, while in the latter they are of various shapes, the distinctive feature being that the ridges correspond to waves of rolling waters. The reasons for the difference may be obvious, but one's curiosity is heightened when one notes a similar difference characterising the enclosing of lands for residences in both the countries. Wavy ridges again appear to have their counterparts in the meandering jungle paths in Kandyan villages, while the lanes in the North run straight as are the ridges of fields there.

In the measurement of lands, the extent indicated, say, by the amunam is not a fixed measure equal to so many acres, but varies according to districts, being rather a measure of the crop to be raised from it than of the land.

If the agricultural implements of different districts, say, Nikaweretiya, Anuradhapura, Jaffna and Kandy be examined and compared, they will show differences, the nature of which will be in a general way explained by climatic and soil differences, as also by the physical fitness of the people using them.

The Irrigation rules, which are but a collection of customary rules, recognise the differences in aptitudes and capacities of the people inhabiting the various districts.

In the methods of cultivation, Jaffna is keenly *intensive* ; yet the agricultural terms and aphorisms that have been transmitted hark back to a time when the *extensive* method must have been the rule there.

In the Metayer (*Sinhalese* Ande, *Tamil* Vara) system, the details of division of produce vary considerably in different districts, explaining the economical and sociological conditions peculiar to each district.

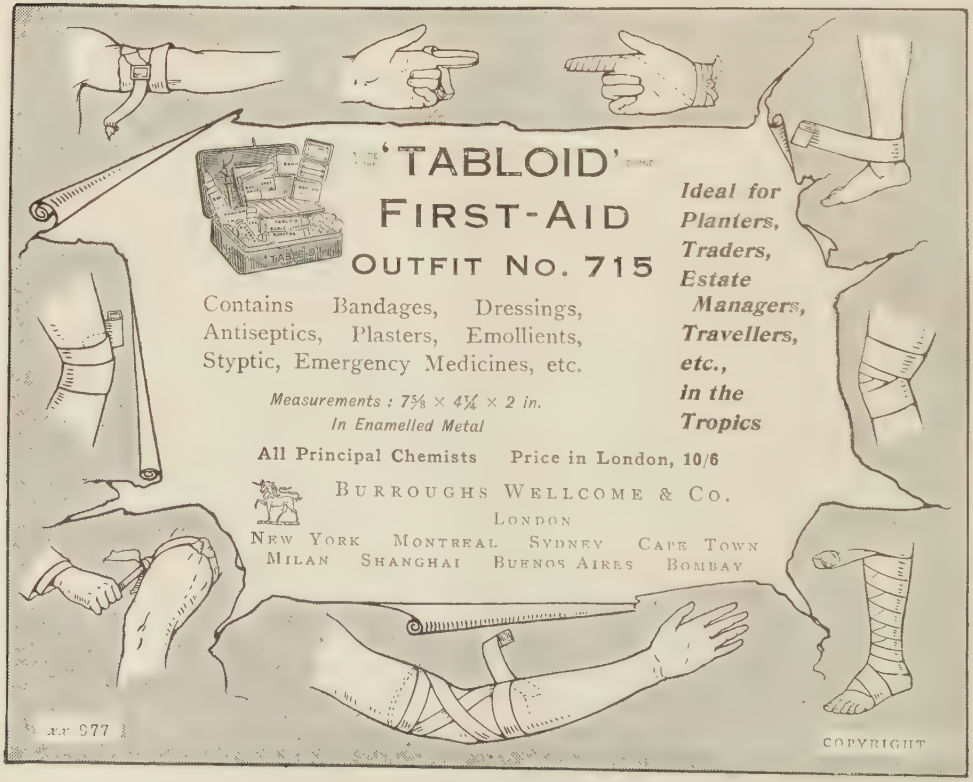
Yet amidst these differences it is easy to discern that the purpose and ideals of the peasantry as a whole are one and the same tending to reach the same goal.

A village field with its tank and appurtenances cannot fail to strike a student in the light of a historical record of the village. At a glance an estimate of the village community can be formed : its past condition, vicissitudes, and its present communal strength. To follow the village community at work from the time of sowing till the sharing of crop is full of interest. Cultivation commences with religious ceremonies and prayers. The ceremonies have been the subject of many learned papers read before the

local branch of the Royal Asiatic Society, yet the subject has not been exhausted. More interesting than religious ceremonies are the social and civic functions attending the cultivation. During season of cultivation the field presents the appearance of a festive occasion. Especially is this the case at harvesting time, when the whole village turns up. Men fall into work in the order of precedence assigned by age-long custom. While at work, heroic songs and ballads are sung sometimes to the accompaniment of tom-tom, the sickle keeping time to the tune. The children serve betel and beverages. The women are busy cooking meals for the community. Work proceeds in the spirit of holiday-making. After the day's work is done, dinner is served to the party who sit in the order of precedence attaching to each caste.

The division of crop at the threshing floor is suggestive of the civil ideal of the peasant population. The priest, the headman, the artisans, the dhoby, the barber, the tom-tom beater, the poor of the village—all come in for their "shares." In the giving *noblesse oblige* is a more potent consideration than profit of business. Religion, education, government, handicrafts, charity—all seem represented at the peasant's threshing floor.

But new times new manners. The old family ties and communal attachments are becoming loosened, being supplanted by cash-nexus, and men are flocking into estates and towns in search of employments. Wages are low, while cost of living is rising. The problem must be faced and solved. We appeal to the educated classes to take an abiding interest in the concerns of the peasantry.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SUGAR FROM THE NIPA PALM.

Attention has been drawn in these pages to the commercial possibilities of Nipa Palm (*Nipa fruticans*) which covers large areas of swamp land in various parts of the tropics. The palm is found widely in Burma, Lower Bengal, the Andamans, Chittagong and Ceylon. The requirements for its growth and proper development are said to be few, consisting of low river land subject to periodic overflow by brackish tide water. Large areas of this character, covered almost exclusively with the nipa palm, exist in several provinces of the Philippine Islands. The determination of the Philippine Government to place the manufacture of native drinks, alcohol and spirits generally, upon a revenue basis led to some investigation into the merits of this palm from an industrial standpoint. The Bureau of Science at Manila, which took up the investigation, published in 1911 two important reports covering the results of their researches. The reports, which were summarised in the Indian Trade Journal of 11th April, 1912, went to show that the cost of producing alcohol from the nipa palm was 2·7 cents gold per litre (1·05 quarts) as compared with 5·8 cents per litre for alcohol from sugar beets at $5 per ton : 5 cents for alcohol from sugarcane at $3·25 per ton ; 3·4 cents from Cassava at $5 per ton ; 6·6 cents from maize at 70 cents per 56-pound bushel, and similar cost from other sources.

A recent issue of the Philippine Journal of Science publishes the results of further investigations into the possibilities of the nipa palm as a commercial source of sugar. A brief summary of the results will probably be of interest to readers who have followed the earlier investigations. It is shown that, in the Philippines, nipa palms produce about 40 litres (8·8 gallons)

of sap per tree during an average season. A conservative estimate of producing palms may be placed at 750 per hectare (304 per acre), yielding 30,000 litres (6,600 gallons) of juice. The nipa district in the Provinces of Bulacan and Pampanga alone is estimated to contain 18,000 hectares (44,460 acres), and many other large areas in various islands are available for sugar manufacture.

The average season during which sap is available in sufficient quantities to supply a sugar mill covers approximately six months. The daily collections reach a maximum during the second month, and gradually diminish after the third or fourth month.

The average nipa sap as it flows from the palm during the season contains about 15 per cent. sucrose, and has an apparent purity of not less than 85. Invert sugar is present only in traces. About 0·5 per cent. of sodium chloride slightly reduces the purity without lowering the extraction of sugar, as it is classed among the non-melassigenic salts. Waxes, acids, pectins, and other foreign material are practically absent. The sap contains active enzymes of the invertase and peroxidase types, the latter being present only during the final period of secretion. This peroxidase is capable of oxidizing sucrose and invert sugar in either neutral or alkaline solution.

Nipa sap may be collected without appreciable deterioration in bamboo joints or tuquils containing lime cream and sulphite. The latter may be added to the lime at the mill by passing the requisite amount of sulphur dioxide into a lime cream of proper consistency. The presence of this additional preservative in the lime cream will destroy the enzymes present and prevent deterioration of the sap. It also avoids the necessity of further bleaching. The use of small funnels for conveying the inflowing juice to the bottom of the tuquils avoids stratification and results in more perfect preservation. The additional expense attendant upon their use is slight, and more than counterbalanced by the resulting advantages.

Nipa sap may be collected and delivered to a mill on a commercial scale with negligible loss of sucrose and decrease in purity for approximately three pesos (1·50 dollars United States currency) per 1,000 litres (220 gallons).

Approximately 115 kilograms (253 pounds) of commercial white sugar, polarizing at from 99° to 99·5°, can be recovered from 1,000 litres (220 gallons) of sap possessing average composition. In the opinion of those who conducted the investigations no important modification of methods now used in sugar practice will be necessary. Furthermore, no expense corresponding to the grinding of cane or the extraction of beets need be included in the cost of manufacture. The lack of fuel caused by absence of bagasse may be largely overcome by utilizing the cheap and plentiful wood of mangrove swamps. Manufacturing sugar from nipa sap will be less expensive than from cane or sugar beet.

About 9,000 litres (1,980 gallons) of nipa sap will be required to produce 1 metric ton of 96° sugar: therefore, a 10-ton mill running at full capacity will necessitate 90,000 litres (19,800 gallons) of sap daily. One hectare (2·47 acres) of nipa swamp yielding 30,000 litres (6,600 gallons) of juice per season should produce from 200 to 250 litres (44 to 55 gallons) per day during the months of maximum flow. Therefore, about 450 hectares (1,111·5 acres) of good producing swamp would supply such a mill operating at full capacity during the height of the season. Many distilleries at the present time are receiving a larger volume of juice per day than is required in this estimate. Some of the factors concerning the yield of sap per hectare and the cost of production cannot be accurately determined, but, it is remarked, that this phase of the problem has been investigated as thoroughly as possible, and ample margins of safety have been allowed in every case. A mill designed to manufacture sugar from nipa juice will also be available during that portion of the year when no sap is flowing for refining Philippine sugars, in which there is a reasonable profit.

In conclusion the report states that a further study of the various enzymes present in the nipa palm is in progress to determine, if possible, the exact nature and action of the one responsible for the destruction of sugar.—Indian Trade Journal.

NOTES ON CORN GROWING IN GUAM.

Corn (i.e. Maize.—Ed.), now the most important food crop in Guam, has been grown and utilized for food purposes for a period of more than 200 years. The original introduction of corn into Guam is said to have been made from Mexico, where it had grown under climatic conditions not widely different from those which obtain in Guam. Now at least this old strain shows much greater adaptation to local environments than the highly improved varieties grown on the mainland of the United States, which do not succeed in Guam. Prior to introductions recently made by this station there was but a single variety grown on the island, a hard, flinty, white corn with broad, shallow grains and a large white cob.

There are two general corn-planting seasons. The principal crop is planted in April or May, dependent on favourable weather conditions, and the crop develops in the season of comparatively light rainfall preceding the excessively wet period. It reaches maturity in about four months from planting. A second important crop is planted in November or December, following the period of heavy rains, and matures during the period of diminishing rainfall. In addition to these two principal crops a limited quantity of corn is planted at various times throughout the year, these plantings being largely controlled by special conditions which in the dry season furnish a water supply from underground seepage or unusually good drainage in the season of heavy rains.

The cultural methods employed in growing the corn crop in Guam are of the most primitive nature. The fosino is almost the only tool used. It is employed to remove vegetation from the land in preparation for planting and in cultivating the crop by the occasional removal of weeds with a simultaneous stirring of the surface soil. An interesting feature in the cultivation of corn in Guam is the custom of breaking or doubling the stalk just below the ear when the latter has reached a condition of maturity by a partial hardening of the grain. This operation leaves the ear with the point hanging downward and has the effect of hastening the maturity of the crop and prevents the collection of water under the husk, where in the natural position it would be retained, causing germination or decay of the grain. In a climate characterized by high temperatures and heavy rainfall such as obtain in Guam some protective measures are necessary to prevent general loss to the crop, and this practice of doubling the stalk is both simple and effective. Observations on the amount of labour required to perform this operation have been recorded at this station, and these indicate that a man working in corn of average stand and growth will double an acre in four hours.

Corn is not allowed to dry in the field, but is gathered and shelled before drying. This practice renders machine shelling impossible, and the entire product of the island is shelled by hand. As an evidence of the uncured state in which corn is gathered a shrinkage equal to 31 per cent. of the original newly husked corn has been noted at this station during the process of drying. An acre of corn grown at the station produced 27·75 bushels of corn in Guam. Corn is bought and sold in terms of "tinajas," a measure equivalent to about 98 pounds, or less frequently in "kabans," each of which is equal to about 154 pounds. Prices demanded generally range from $1 to $2 United States currency per tinaja.—Annual Report of the Guam Agric. Expt. Station for 1912.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic „	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow „	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached „	Fair to good	£8 10/a £8 12/6
„ unbleached „	Dark to good genuine	£6 5/ a £7
Madagascar „	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin per lb.	Good to fine bold	5/9 a 6/
	Middling lean	4/8 a 5/4
Malabar, Tellicherry „	Good to fine bold	5/9 a 6/3
Calicut „	Brownish	3/9 a 5/3
Mangalore „	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore „	Small fair to fine plump	4/ a 6/4
Malabar „	Fair to good	3/2 a 3/4
Seeds, E. I & Ceylon „	Fair to good	4/ a 4/3
Ceylon "Long Wild" „	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta „	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan „	Fair bright small	60/ a 70/
CINCHONA BARK.—lb. Ceylon	Crown, Renewed	3⅜ d a 7 d
	Org. Stem	2d a 6d
	Red Org. Stem	1¾ d a 4¼d
	Renewed	3d a 5½d
	Root	1½d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	„ „	1/2 a 1/7
3rds.	„ „	1/1 a 1/6
4ths.	„ „	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna „	Dull to fine	10d a 10½d
Zanzibar „	Fair and fine bright	5⅝d a 6¼d
Madagascar „	Fair	7d
Stems „	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian „	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. „	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate „	Ordinary to red	42/ a 68/
Java and Celebes „	Small to good red	30s a 93s
COLOMBO ROOT „	Middling to good	15/ a 22/6
CROTON SEEDS, sifted „	Dull to fair	42/6 a 47/6
CUBEBS „ „	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough „	Fair	19/
Calicut, Cut A „	Medium to fine bold	75/ a 85/
B & C „	Small and medium	35/ a 74/
Cochin, Rough „	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan „	Unsplit	20/
GUM AMMONIACUM „	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
„	„ „ little red	£11 a £12
„	Bean and Pea size ditto	70/ a £11
„	Fair to good red sorts	£8 10/ a £10 10/
„	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar „	Fair to good palish	£4 a £8
„ „	red	£4 a £7
ARABIC, E. I. & Aden „	Ordinary to good pale	26/ a 32/6
Turkey sorts „	„ „	37/ a 57/6
Ghatti „	Sorts to fine pale	17/ a 27/
Kurrachee „	Reddish to good pale	22/6 a 32/6 nom.
Madras „	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA „	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali „	„ „	52s 6d a 55s
OLIBANUM, drop „	Good to fine white	45s a 50s
„	Middling to fair	35s a 40s
pickings „	Low to good pale	15/ a 27/6
siftings „	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
	Crepe ordinary to fine	2/2½
Ceylon, Straits, „	Fine Block	2/4½
Malay Straits, etc. „	Scrap fair to fine	1/8 a 1/9
Assam „	Plantation	1/10
„	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon „	„ „ „	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo „	Common to good	9d a 1/3
Java „	Good to fine red	1/3 a 1/6
Penang „	Low white to prime red	9 d a 1/4
Mozambique „	Fair to fine red ball	1/9 a 2/1
„	Sausage, fair to good	1/9 a 2/
Nyassaland „	Fair to fine ball	1/9 a 2/
Madagascar „	Fr. to fine pinky & white	1/4 a 1/6
„	Majunga & blk coated	1/ a 1/2
„	Niggers, low to good	6d a 1/6
New Guinea „	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal „	Shipping mid to gd. violet	3s 3d a 3s 8d
„	Consuming mid. to gd.	2s 9d a 3s 2d
„	Ordinary to middling	2s 4d a 2s 9d
„	Mid. to good Kurpah	1s 11d a 2s 5d
„	Low to ordinary	1s 6d a 1s 9d
„	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang per lb.	Pale reddish to fine	2/4 a 2/6
	Ordinary to fair	2/ a 2/2
Java	„ „ good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang „	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	„ „	12/
Madras	„ „	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA „	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2½d
NUTMEG „	Dingy to white	1½d a 1/8d
CINNAMON „	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon „	Fair	10/6
Madagascar „	Fair	10/6
Zanzibar „	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon „ „	Fair to fine bold heavy	5d a 5⅜d
Singapore ...	Fair	4⅝d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore „	Fair to fine	8½d a 8¾d
Siam „	Fair	8¼d
Penang „	Fair	7⅜d
Muntok „	Fair	9d
RHUBARB, Shenzi „	Ordinary to good	2/ a 4/
Canton „	Ordinary to good	1/10 a 3/6
High Dried „	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large--cwt	Fair to fine	18/
medium ..	„ „	16/
small ..	„ „	13/ a 14/
Flour ...	Good pinky to white	10/ a 11/
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay „	„ „	85/ a £6 10/
Mergui „	Chicken to bold	£8 12/6 a £145/
Manilla „	Fair to good	£7 17/6 a 13 10
Banda „	Sorts	50/ nom.
Green Snail „	Small to large	70/ a 85/
Japan Ear „	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras „	Finger fair to fine bold	14/ a 16/
Do. „	Bulbs „ „ [bright	12/ a 13/
Cochin „	Finger fair	13/ nom.
	Bulbs „	11/6 a 12/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... } 2nds.	Foxy & reddish 3½a „	9/ a 12/
Seychelles ... } 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6